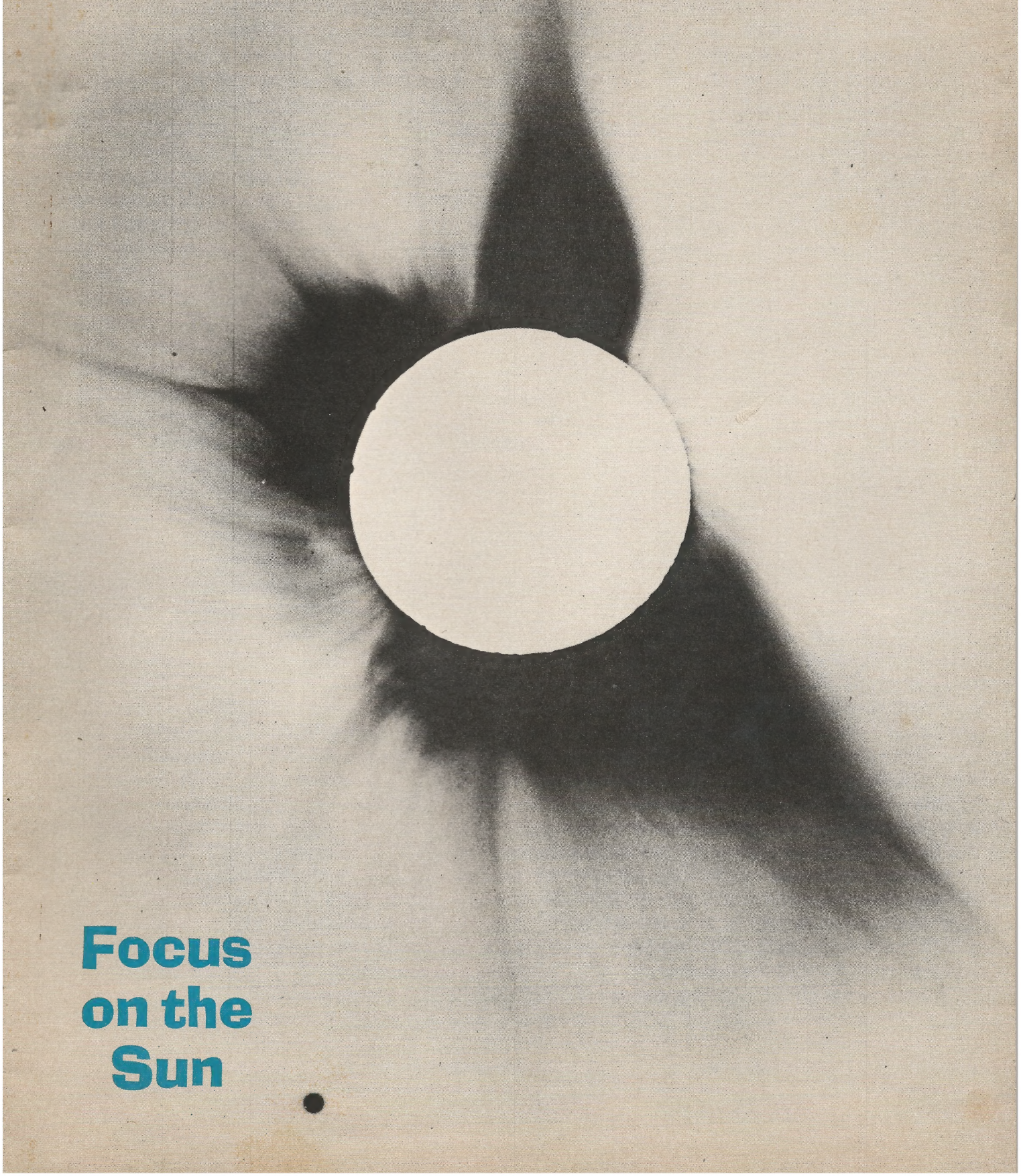
MARCH 14, 1968 • VOL. 23 • NO. 6 • A SCHOLASTIC MAGAZINE

SENIOR SCIENCE

For Classes in Biology, Chemistry, Physics, Earth and Space Science



Focus on the Sun

TENDER TRAP

French girls are born knowing it. Swedish girls learn it at their mothers' knee. And American girls are quick studies. You know, about how a boy chases a girl until she catches him. The tender trap. And every girl who sets one knows how to do it. But don't forget this: boys love to eat. And they love Wonder sandwiches. And Wonder helps build strong bodies 12 ways . . . so see how good *you* are for him. Get Wonder going for you, too. Set your tender trap with Wonder as bait. You can't lose.

WONDER
ENRICHED BREAD
helps build strong bodies 12 ways.

Helps catch boys...!

THE BEST CATCH IN BASEBALL IS THE WILSON A2000.

And that's the best catch phrase a ball player can keep in mind. Especially coming from Ron Santo*, a man to whom catching is a way of life.

Ron's been playing the A2000 ever since he joined the major leagues.

And it's paid off. In 1967 he was named outstanding fielding third-baseman of the year, an honor he's grabbed four straight years.

Catching the ball and holding on to it: a way of life for a fielder that demands some mighty ingenious engineering features in a glove.

The patented web, for example, is adjustable and vertical dual-hinged. This glove really swallows the ball whole!

Snap-Action palm lacing allows glue-finger control. The glove closes instantly, releases instantly for making fast plays without a hitch.

Streamlined back fingers are shaped in natural playing position—they're poised to nab the pill before you are! And the new adjustable wrist strap assures firm control.

The Wilson A2000 is almost too good to be true. But if you ask Ron Santo what the catch is, he'll probably refer you to his fielding average.

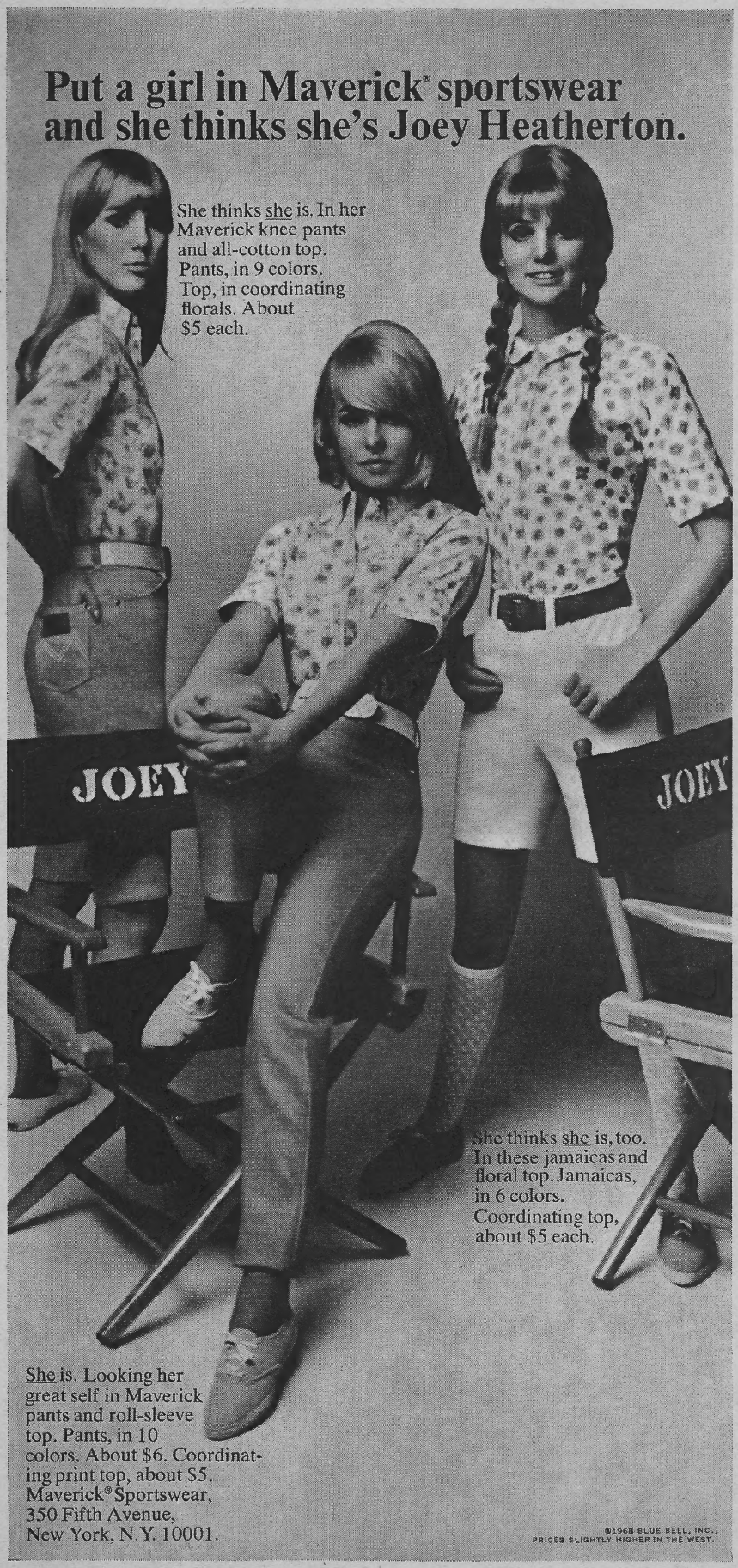
Catch?

ASK RON SANTO.

Wilson®

*Member of Wilson Advisory Staff.

Wilson Sporting Goods Co., River Grove, Ill.
A subsidiary of Ling-Temco-Vought, Inc.


Put a girl in Maverick® sportswear and she thinks she's Joey Heatherton.
She thinks she is. In her Maverick knee pants and all-cotton top. Pants, in 9 colors. Top, in coordinating florals. About $5 each.
JOEY
JOEY
She thinks she is, too. In these jamaicas and floral top. Jamaicas, in 6 colors. Coordinating top, about $5 each.
She is. Looking her great self in Maverick pants and roll-sleeve top. Pants, in 10 colors. About $6. Coordinating print top, about $5. Maverick® Sportswear, 350 Fifth Avenue, New York, N.Y. 10001.
©1968 BLUE BELL, INC.
PRICES SLIGHTLY HIGHER IN THE WEST.

ANSWERS TO BRAIN TEASERS

(see page 30)

Penny-Wise

Tom should get three full banks, one half-full bank, and three empty banks. Dick and Harry should each get two full banks, three half-full banks, and two empty banks. Each brother then receives seven banks containing the equivalent of three and one-half banks full of pennies.

In Gear

Two intermeshed gears must turn in opposite directions. Thus, every other gear turns in the same direction. Accordingly, the seventh gear will be turning in the same direction as the first, clockwise.

Challenging

$0 + 1 + 2 + 3 + 4 + 5 + 6 + 7 + (8 \times 9) = 100$

$0 + 1 + (2 \times 3) + 4 + 5 + 67 + 8 + 9 = 100$

$0 + (1 \times 2) + 34 + 56 + 7 - 8 + 9 = 100$

$0 + 123 - 45 - 67 + 89 = 100$

Editor's Choice

The first weighing should be made with three coins on one side of the balance and three coins on the other side.

If the six coins balance, the light coin is among the three remaining. Weigh two of those – one against the other. If they balance, the remaining coin is light. If one is lighter than the other, it is the light coin.

If the first six coins do not balance, the light coin must be among the three on the side that is light. Weigh two of these against each other. If one is lighter than the other, it is the light coin. If they balance, the remaining coin is light.

SENIOR SCIENCE

Published by Scholastic Magazines, Inc., publisher of periodicals and books for elementary and secondary schools.

The Staff

EDITORIAL DIRECTOR: Eric Berger
MANAGING EDITORS: Arthur Fisher, Carl Proujan
EDITOR, AUDIO-VISUAL MATERIALS: Simon Dresner
ASSOCIATE EDITORS: Michael Cusack, John Speicher, Thayer Willis
ASSISTANT EDITORS: Ann Clarke Gill, Robert Wersan
PRODUCTION EDITOR: Dona Fowler Kaminsky
ART DIRECTOR: Charles Hurley
ART EDITOR: Sam Ruvidich
PRODUCTION DIRECTOR: Jane Fliegel
LIBRARIAN: Lavinia Dobler
PHOTO EDITOR: Lucy Evankow
CONTRIBUTING EDITORS: Alfred D. Beck; Dr. Theodore Benjamin; Maurice Bleifeld; Kenneth Bobrowsky; Richard Harbeck; Dr. Alexander Joseph; Herman L. Masin; Richard Spaulding; Marshall Spiegel; Stanley L. Weinberg.
PUBLISHER AND SENIOR VICE PRESIDENT: Jack K. Lippert
ASSOCIATE PUBLISHER: Clayton C. Westland
MANAGER, HIGH SCHOOL DIVISION: Nicholas Kochansky

Editorial Executive Staff for Scholastic Magazines

Maurice R. Robinson, Chairman of the Board of Directors • Donald E. Layman, President • G. Herbert McCracken, Vice-Chairman of the Board of Directors • John P. Spaulding, Executive Vice-President • John W. Studebaker, Vice-President and Chairman of the Editorial Boards • William D. Boutwell, Editorial Vice-President and Publisher of *Scholastic Teacher* • Richard V. Holahan, Vice-President • Kenneth M. Gould, Editor Emeritus • Leonard Berkowe, Promotion Director • Robert J. Loveling, Manufacturing Director • Michael Fidan, Special Services Director • Advertising Sales Dept: Edward Chenetz, New York Manager • Ray Barnes, Chicago Manager • C. C. Pendray, Detroit • Madelaine Schwendeman, Advertising Production Manager

National Advisory Council of Scholastic Magazines

Dr. John W. Studebaker, Vice-President of Scholastic Magazines (Chairman) • Dr. Melvin W. Barnes, Superintendent of Schools, Portland, Ore. • Dr. George B. Brain, Dean, College of Education, Washington State University, Pullman, Wash. • Dr. William H. Curtis, Superintendent of Schools, Manchester, Conn. • The Rev. C. Albert Koob, Executive Secretary, National Catholic Educational Association, Washington, D. C. • Dr. Paul F. Lawrence, Regional Assistant Commissioner, U.S. Office of Education, HEW, 50 Fulton St., San Francisco, Calif. • Dr. John W. Letson, Superintendent of Schools, Atlanta, Ga. • Dr. Paul A. Miller, Superintendent, Cincinnati Public Schools • Dr. Wendell H. Pierce, Executive Director, COMPACT, Education Commission of the States, Lincoln Street, Denver, Col. 80203 • Dr. Ellsworth Tompkins, Executive Secretary, National Association of Secondary School Principals, Washington, D. C.

Science Advisory Board

Mr. Rolland Bartholomew, Sci. Teachg. Ctr., U. of Md., College Pk., Md.
Mr. Vernon Bice, Alhambra H.S., Phoenix, Arizona
Mr. Kenneth Borst,* Rhode Island College, Providence, R.I.
Dr. Hilary Deason, American Association for the Advancement of Science, Washington, D. C.
Mr. Milford J. Deprey, Amity Regional Jr. H.S., Orange, Conn.
Mr. Gene Doty,* Hillsboro H.S., Hillsboro, Ore.
Mr. Alfred D. Morse, Eastview Jr. H.S., Bath, Ohio
Dr. Ellsworth S. Obourn, Specialist for Science, U.S. Office of Education, Washington, D.C.
Sister M. Rosalma, C.S.S.F., Immaculate Conception H.S., Lodi, New Jersey
Mr. Edward G. Sherburne, Jr., Science Service, Washington, D.C.
Mr. B. J. Woodruff,* New York University, New York, N.Y.
**Representing the National Science Teachers Association*

SENIOR SCIENCE, published weekly during the school year September through May, except during holidays and midterm. Second-class mail postage paid at Dayton, Ohio. Copyright © 1968 Scholastic Magazines, Inc. All Rights Reserved.
SUBSCRIPTION PRICES: $2.00 per school year, $1.25 per semester, for two or more subscriptions to same address. Single subscription, student edition, sold on an annual basis only, $2.40 per year. Single copy 10 cents. Teacher Edition $5.00 per school year. In Canada: $2.20 per school year, $1.35 per semester, for two or more subscriptions to same address; single subscription, student edition, sold on an annual basis only, $2.60 per year; Teacher Edition $5.20 per school year. Office of publication, McCall St., Dayton, Ohio 45401. Printed in U.S.A.

General and Editorial Offices: SENIOR SCIENCE, 50 West 44 St., New York, N.Y. 10036. **Address subscription correspondence to** SENIOR SCIENCE, 902 Sylvan Ave., Englewood Cliffs, N.J. 07632. **Canadian address:** Scholastic Publications, Richmond Hill, Ontario. **Postmasters:** Send notice of undelivered copies on Form 3579 to Scholastic Magazines, 430 Kinnard Ave., Dayton, Ohio 45401.

CONTENTS

MARCH 14, 1968 • VOL. 23, NO. 6

Features

The Cellular Pendulum 4
by Robert L. Wersan

Microfossils — Clues to the Past 7
by Ann Gill

Scrapie — The Smallest Killer 10
by John Speicher

Senior Science Takes You There 13
Sun Watching Atop a Volcano

Science in the News 16

Tomorrow's Scientists 18
Project by Arthur N. Fankuchen

Departments

Project Pointers 20

News on Wheels 22

Science Scoreboard 24

Sports 26

Following the Films 27

Girls' Grooming/For Further Reading 28

DISCussions 29

Brain Teasers 30

Girls' Nutrition 31

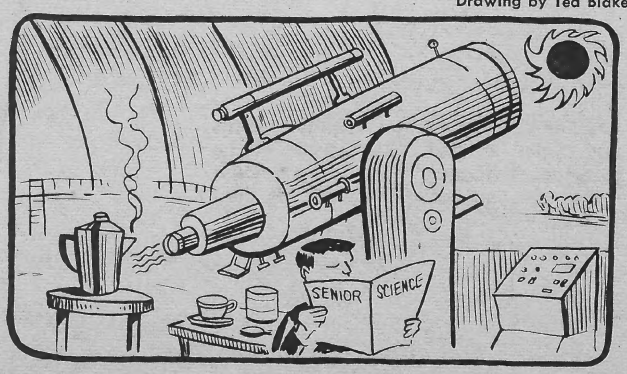
Crossword Puzzle/Science on TV 32

Cover photo courtesy NCAR

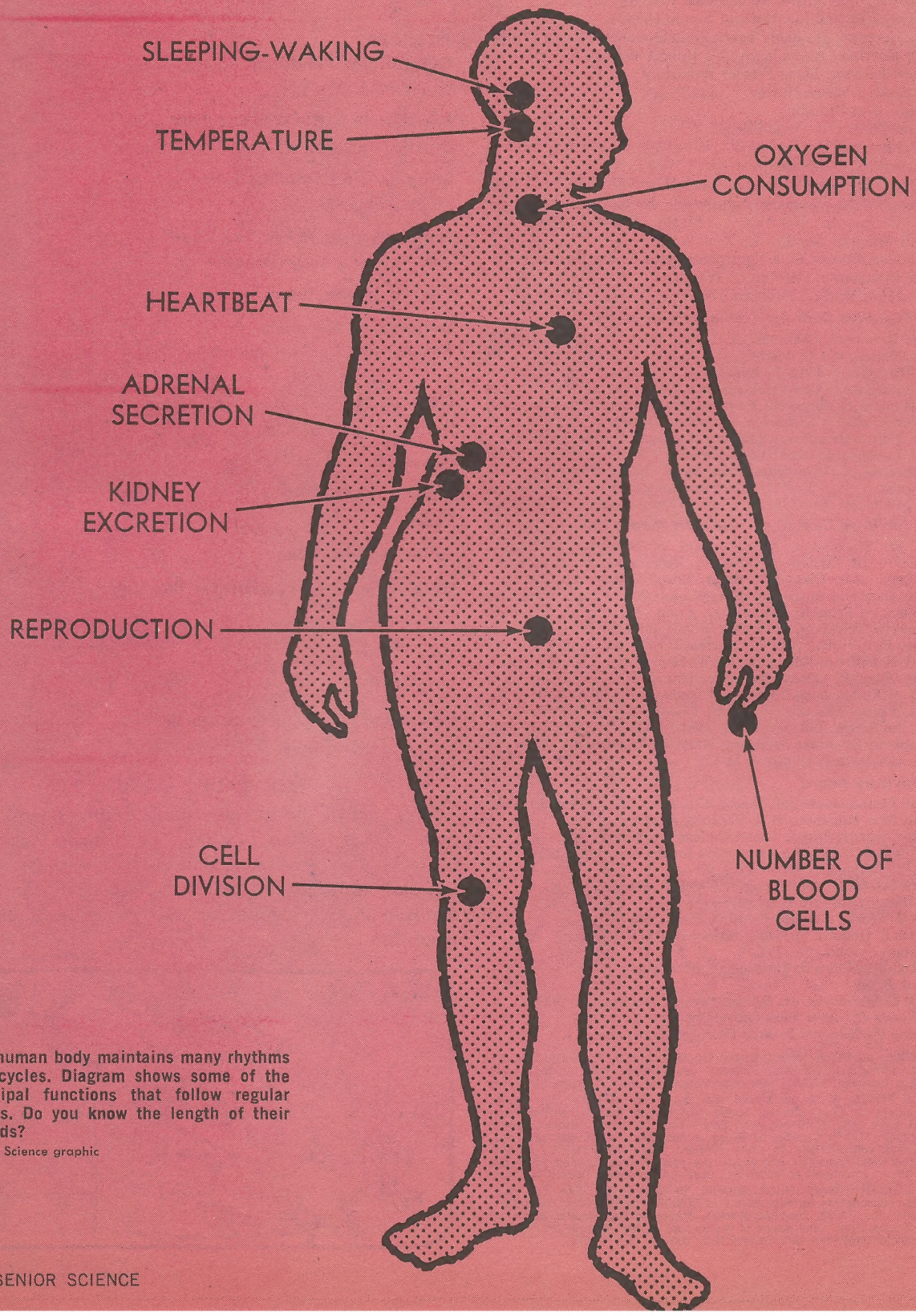
Our Front Cover

This shot of the sun was taken during a total solar eclipse. It is printed as a *negative* to make our focus on the sun more *positive:* The sun's corona now turns out dark and somehow ominous. Read about the latest sun-watching techniques in the article beginning on page 13.

Drawing by Ted Blake



The Cellular



The human body maintains many rhythms and cycles. Diagram shows some of the principal functions that follow regular cycles. Do you know the length of their periods?

Senior Science graphic

Pendulum

FOR NEARLY TWO WHOLE DAYS the townspeople of North Conway, New Hampshire, did not know what time it was.

No fire siren signaled noon. No church bells chimed the hours. All the public clocks were useless; their faces were covered with sheets of white plastic or cardboard bearing bright red question marks.

These strange goings on were part of an experiment called "Project Time Out." The object was to discover how people would react when they had no precise way to tell time.

Two days before the project began, North Conwayans were asked to turn in their watches for the duration of the time out. They cooperated, as did the local radio station, which did not broadcast the time.

Some results: One woman fled her house, driven out by the stench of overcooked eggs. One morning, 238 of 240 children appeared at the schoolhouse a half-hour early – "just in case." The previous morning, most of them had been late.

After it was all over, researchers interviewed the townspeople for their reactions. Most reported that they had been uneasy and anxious without a way to measure time – although they generally enjoyed the experiment. One North Conwayan said he felt as though he were "floating in mid-ocean without a compass." Almost all agreed that they had never realized how important clocks, watches, and the like were to their everyday lives.

Despite their dependence on timepieces, human beings do keep pretty good time. Some people are routinely able to awaken before their alarms go off. Others can estimate the time of day to within five minutes, without a clock or watch. But everyone, even those who confess to a poor sense of time, shares the ability to keep very good time without ever being aware of it. How?

Human beings, along with other animals and with plants, have an inner sense of timing. The workings of their bodies follow regular cycles that are not controlled by watches, clocks, or even the sun. Each of us is familiar with his own rhythmic heart beats – normally about 72 per minute. But there are daily rhythms, too. Over a 24-hour period there are changes in the pulse rate, body temperature, and the numbers of certain kinds of white blood cells. These *physiological* changes repeat themselves daily in predictable up-and-down swings. (Such daily rhythms are called *circadian* rhythms, from the Latin *circa* for "approximately" and *dies* for "day." Circadian rhythms have a period of about a day.)

There have been many studies of human circadian rhythms, and many attempts to change them. In one experiment, carried out by British scientists, a group of volunteers was sent to the Spitzbergen Islands, north of Norway and within the Arctic Circle. It was the arctic summer, and the sun did not set. The men were to live in continual daylight.

Fiddler crabs change color according to sun and tide rhythms. They are light-colored at night and begin to darken near sunrise. They are darkest at low tide, when they are most active.
George Porter photo from National Audubon Society

The volunteers were to live in two groups in two separate colonies. Just before their stay in the Arctic began, they were asked to surrender their wristwatches. They were issued new ones, but these were "dishonest." Watches given to one group were set to run slow; they *lost* three hours a day. Watches given the other group were set to run fast; they *gained* three hours a day. So when the first group thought 24 hours had passed, 27 hours actually had. And when the second group's watches told them 24 hours had passed, only 21 hours actually had.

Since they were living in continuous daylight, and the groups were isolated from one another, the men had no way of knowing that they were on artificially long or short days. The men's activity *patterns* followed regular "24-hour" schedules. They ate, worked, and slept according to their lying watches. What happened to their circadian rhythms? All body cycles changed to fit the new "daily" pattern – with one exception!

It turned out that the changes in body temperature followed the cycle of activity, regardless of whether it took 21 hours or 27 hours: Temperature rose while the men were awake and fell while they were asleep. Although it took two or three weeks to adjust to the new time, the cyclic pattern of urine excretion for both groups also began to follow the activity pattern. More urine was excreted during waking hours than during sleeping hours, regardless of day length.

But, when scientists analyzed the amounts of potassium excreted in the men's urine, they had a surprise: Potassium excretion continued according to a 24-hour rhythm. This tallied with results of similar experiments in which people had been intentionally thrown off a normal, 24-hour schedule.

Continued on next page

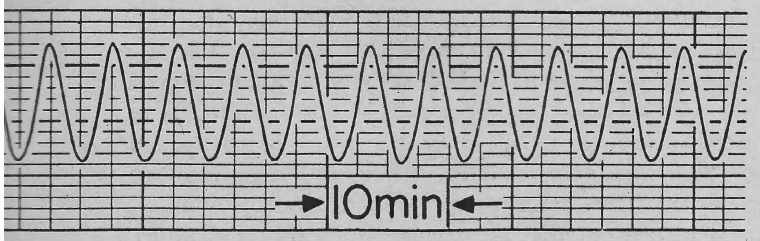
The Cellular Pendulum *continued*

The potassium rhythm thus makes a good clock or calendar. All summer long, the dishonest watches failed to influence its rhythm. All other bodily rhythms seem to have been modified by adjustment to the new day length. Here seemed to be a true 24-hour – circadian – rhythm.

Recent experiments in the basic workings of the cell have begun to shed light on a possible – perhaps universal – mechanism for biological clocks in human beings and animals. The investigations were done by a team of researchers led by Dr. Britton Chance at the Johnson Research Foundation at the University of Pennsylvania. The other members were Dr. Kendall Pye and Dr. Joseph Higgins.

This team of biochemists and biophysicists came up with an *enzyme* called phosphofructokinase, or PFK for short. Like many other enzymes found in the cells of most living things – and PFK is found in bacteria, yeasts, rats, and men – PFK behaves like a catalyst. That is, PFK enables a specific chemical reaction within the cell to occur. Enzymes also control the rate of such reactions. Without enzymes, most biochemical reactions would take place so slowly as to be almost undetectable, even by the most sensitive instruments of chemical research.

Actually, the PFK reaction is but a single step in a whole series of reactions that lead to the breakdown of sugars–usually glucose–into smaller molecules. Equally important is the fact that the breakdown of sugars releases energy. Thus the series of chemical reactions in sugar breakdown – called glycolysis – is actually a stepwise method of energy transfer. The energy is transferred by the completion of molecules, which can be called energy carriers.



Above: Graph shows changes in DPNH concentration keeping good biochemical time. Measurements were made on glycolytic enzyme system extracted from yeasts. Variation amounts to about 10 per cent of total DPNH concentration. Below: Electron micrograph shows mitochondrion (M)—portion of animal cell where glycolysis and "time keeper" are located—enlarged 60,000 X.

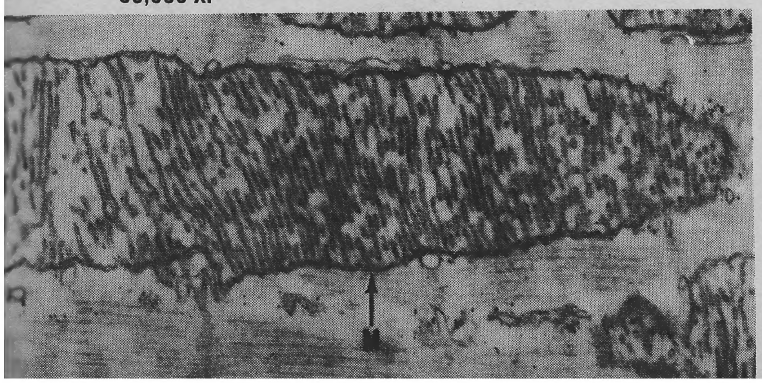


Photo from: Dr. William P. Jollie and Bulletin of Tulane Medical Faculty

Production of energy carriers occurs as a co-product of a number of the reaction steps in glycolysis. The energy carriers can, in turn, transfer their energy to muscles, for useful work, or can be used as energy sources for building new molecules in the organism.

A series of consecutive reactions in a complex biochemical process is called a biochemical pathway. How does the presence of PFK in the glycolytic pathway relate to biological clocks?

Most enzymatic reactions slow down as their end products build up. But the reaction that PFK affects *speeds up* as its end products accumulate. The Chance team knew that this "strange" type of reaction in the pathway should cause some of the products of glycolysis to go through cyclic variations in amount. Such a periodic variation – called an *oscillation* – might serve as the basis for an inner biological clock, just as the oscillations of a pendulum serve as a time standard for a grandfather's clock. But could it be found experimentally?

Pendulum for the Body's Clock

The reseachers measured fluctuations in the amounts of one of the energy transfer compounds found in living cells.

The chemical they measured was *diphosphopyridine nucleotide*, or DPNH for short. DPNH participates as an energy carrier in many biochemical reactions; it is also one of the intermediary products of glycolysis. DPNH is highly fluorescent. That is, when irradiated with ultraviolet light, DPNH emits visible blue light. A highly sensitive instrument called a *microfluorometer* was used to measure the intensity of the blue light. This, in turn, gave the scientists the concentration of DPNH.

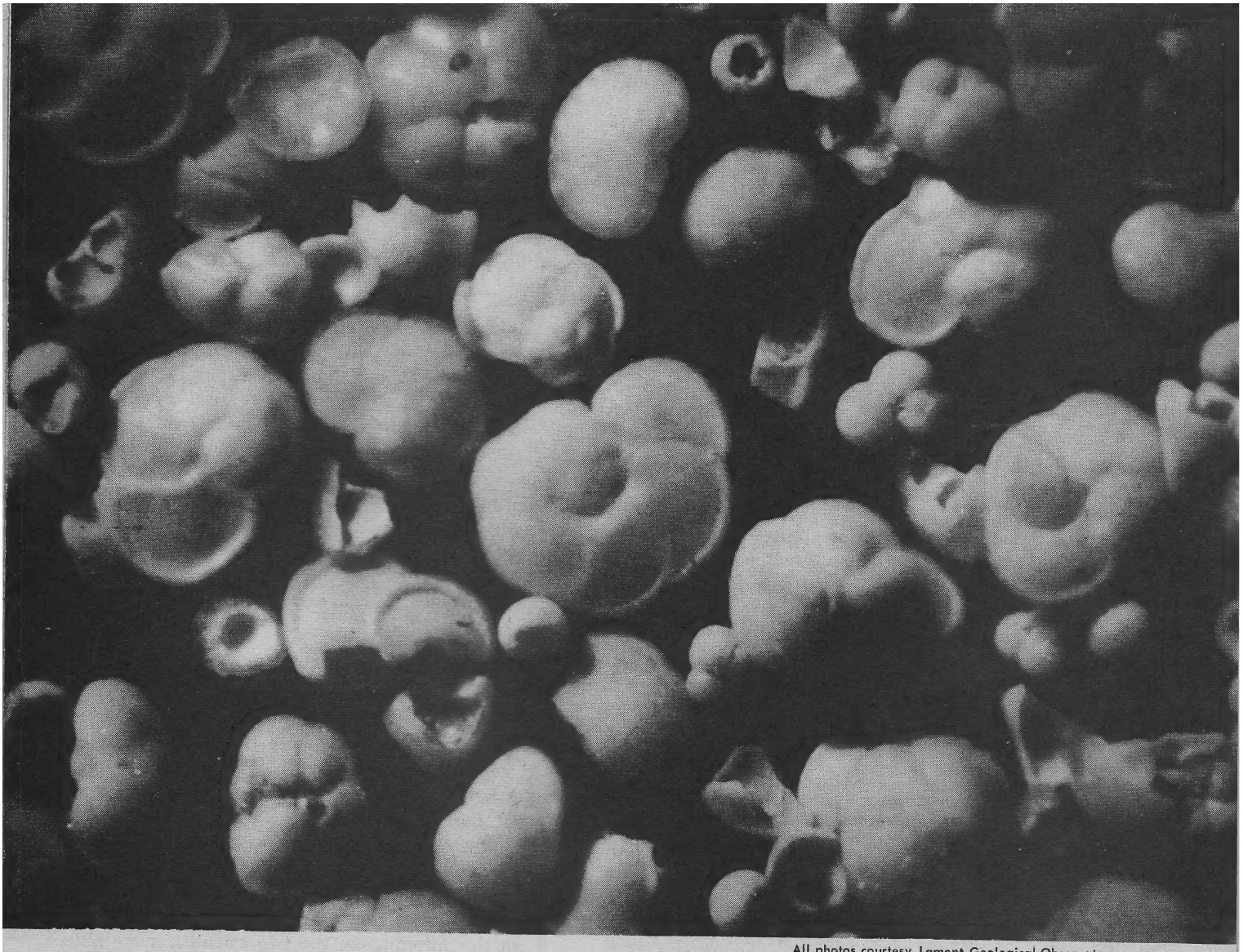
Result? The scientists found rhythmic fluctuations in the intensity of the blue light, with a period of about 40 seconds!

To investigate further, Dr. Chance and his team hit upon a way to break cell walls and extract the oscillating enzyme system intact, without the other cellular constituents. By changing the chemical conditions of the enzyme system, the Chance team was able to change the vibration period, and modify the oscillations in other ways.

Dr. Chance believes that the PFK portion of the glycolytic system acts as a pendulum for the body's internal clock. How? Biochemical pathways between glycolysis and many other of the body's chemical workings are already known. The problem is to find out how the short "ticks" of glycolysis are translated into the slower rhythms of the body.

Why is this research important? At certain times of the day, certain drugs given human beings are more potent than at other times. Certain diseases also seem to have a cyclic nature. Dr. Chance believes that a real understanding of our biological clocks may usher in revolutionary changes in medicine.

— Robert L. Wersan



All photos courtesy Lamont Geological Observatory

Wanted: Dead, not alive! These spiral shapes (magnified 75 times) are forams — tiny sea fossils.

MICROFOSSILS—CLUES TO THE PAST

CAN ANY branch of science be said to have begun in the work of a single man, at a single point in time?

In the first half of the 19th century a French scientist named Alcide d'Orbigny unearthed fossils of tiny one-celled organisms called *Foraminifera*. These animals have lived on the Earth for the past 500 million years. With his work on fossils that could be seen only under the microscope, d'Orbigny launched the science of micropaleontology.

Since his day, scientists have written more than 6,000 papers on "Forams." Tiny fossils of these creatures sometimes appear in numbers as great as 250,000 per cubic centimeter of sea mud. They have provided scientists with the means of identifying oil-bearing rock layers and of dating rock layers millions of years old. They also give clues to Earth's climate as far back as these creatures have existed on this planet.

How do scientists use fossil Forams for these projects? Thousands upon thousands of species of these tiny organisms have appeared on Earth in successive time periods. Each species appeared at one particular time in the Earth's history. Thus they serve as "tags" for scientists who want to know the age of the different sedimentary rock layers (rocks that are deposited by water or wind). Almost all micropaleontologists working for oil companies (men whose job is to locate oil-bearing rock layers) spend their entire careers studying Forams. Scientists have described so many of these tiny creatures that the information fills 67 volumes in a catalogue

Continued on next page

published by the American Museum of Natural History!

With all this attention, it seems impossible that the Forams would have any remaining secrets. But a geologist and his journalistic colleague at the Lamont Geological Observatory in New York discovered otherwise. The pair is interested in using Forams in a study of ancient climates. Dr. David B. Ericson and Goesta Wollin noticed two things about living Forams that did not fit into the current scientific picture of the microscopic animals: They found that Foram species in warm waters are totally different from those in cold waters. This seemed unusual to the Lamont researchers because Forams supposedly spend most of their lives on the ocean floor, where the water temperatures are much the same in tropical, temperate, and polar oceans. The only place where ocean water temperatures vary is at the *surface.*

A second item that appeared strange to Dr. Ericson and Mr. Wollin was that deep-water species of Forams could be collected at the ocean surface. However, they noticed that the animals collected at the surface had very thin, translucent shells. The bottom-dwelling animals of the same species had heavy, thick shells.

Dr. Ericson and Mr. Wollin looked at thousands of microscopic Foram shells. They obtained these shells from *sea cores* – pieces of ocean sediment that had been brought up through holes drilled in the ocean floor. They noticed that shells from the older animals were heavily coated with calcite (one of the compounds of which the shells are built). The younger Forams had much thinner shells.

From this observation, the two scientists deduced that the Forams that float in the photic ocean zone (the surface waters) are young animals. When mature, the animals drop down thousands of feet to the bottom of the water. The animals secrete the material of which their shell is made, so the older they get, the thicker their shells become.

How did this information help Dr. Ericson and Mr. Wollin learn more about ancient climates? Micropaleontologists have learned that shell animals, such as the tiny Forams, absorb different *isotopes* of oxygen in different water temperatures. Isotopes are forms of the same element, such as oxygen, that have different atomic weights. In warm waters, the shells absorb the heavier isotopes of oxygen. In cold water, the shells take in the lighter oxygen.

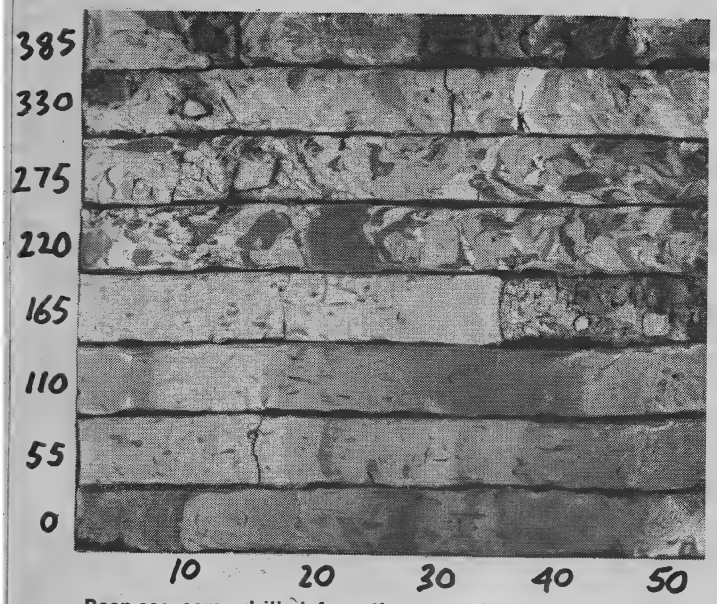
Goesta Wollin, oceanographer, opens a deep-sea core. This chunk of sea mud may reveal thousands of tiny fossils.

New Dates for the Ice Ages

Since water temperature varies with depth, it is important for a scientist who studies the oxygen content of shells to know at what depth the animal absorbed its oxygen. Dr. Ericson and Mr. Wollin analyzed the ratio of light oxygen isotopes to heavy oxygen isotopes in fossil Forams that were as old as 110,000 years. Through their discovery of the movement of the Forams from the photic zone to the ocean bottom, they knew which part of the shell had absorbed its oxygen at the changeable surface temperatures.

From this information, the two scientists were able to calculate an accurate date for the ending of the last great Ice Age. Dr. Ericson and Mr. Wollin estimated that it ended 11,000 years ago. Previously, scientists had set this date at 20,000 years ago. Also, the scientists could tell that the period of time *between* the last two Ice Ages was 30,000 years. They say that, if weather history repeats itself, Earth has another 20,000 years to go before the next period of glaciation begins. Their long-range weather predictions – based on their study of the minute Foram fossils – include a future climate so warm that all the remaining glaciers will melt. This will raise the sea level to such an extent, they say, that New York City may some day be inundated by 30 feet of water.

Compared to some of the fossils that have come under the close scrutiny of micropaleontologists, the 500-million-year-old Forams made a relatively late appearance on Earth. Fossil traces billions of years old, identified by Dr. Elso Barghoorn and Dr. William Schopf, of Harvard University, have pushed back the history of living organisms to a misty beginning that seems as remote as a faraway point in outer space.



Deep-sea cores drilled from the ocean bottom give scientists a year-by-year picture of Earth's history millions of years ago.

On the northern rocky shore of Lake Superior in Canada these scientists collected samples of *chert* – a flint-like rock made of almost pure silica. Geologists estimated the rock's age as 2,000,000,000 years. This ancient chert was exposed on Lake Superior by the erosion of younger rock layers.

Dr. Barghoorn and Dr. Schopf ground and polished samples of this rock. Then they "etched" the rock surfaces with acid. This process dissolves the rock mineral. But any material on the rock surface left by *living organisms* remains untouched by the acid.

Thin slivers of the "etched" rock were examined under an electron microscope. To their amazement, the scientists discovered fossil traces of bacteria and algae that resemble living organisms on Earth today! To complete their analysis of the chert, the scientists examined it under a *spectrophotometer*. This instrument helps scientists identify minute amounts of compounds. With it, Dr. Barghoorn and Dr. Schopf found that the ancient chert also contained *chlorophyll* compounds. Chlorophyll is the substance that sparks *photosynthesis* in green plants. The photosynthetic process is one by which green plants turn carbon dioxide and water into food sugars and oxygen, in the presence of sunlight.

The kinds of bacteria and algae fossils that the two Harvard researchers discovered in the ancient rocks resemble the living thread bacteria and blue-green algae that carry on photosynthetic reactions today. And the additional find of the chlorophyll compounds almost clinches the proof that this reaction – the basis of food supply for all living things today – had evolved much earlier than scientists thought. Moreover, Dr. Barghoorn and Dr. Schopf recently identified similar bacteria fossils in South African rocks that are three billion years old!

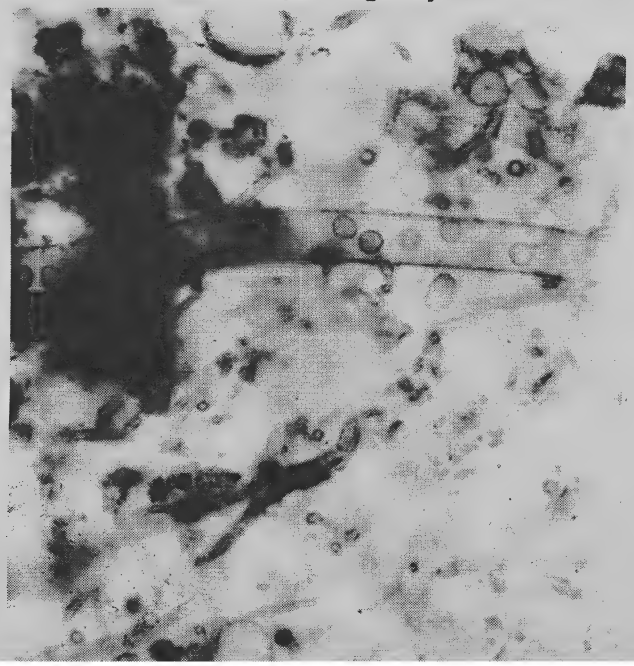
By studying the ancient rocks in which these billion-year-old fossils are found, micropaleontologists hope that they can describe how life evolved on Earth. One important conclusion they have drawn is: The atmosphere on Earth when the first photosynthetic reaction occurred contained little oxygen. These reactions in single-celled bacteria and algae must have released large quantities of oxygen in local areas. Dr. Preston E. Cloud of the University of California at Los Angeles suggests that this local oxygen may have caused the depositing of an iron rock (hematite). This rock, which is very common in old rock sediments, is formed by the combination of iron and oxygen. Scientists think this formation of hematite by early organisms may have speeded up the appearance of oxygen in the Earth's atmosphere.

Geologists have learned that most of the oxygen in the atmosphere comes from within the Earth via volcanic eruptions. This volcanic oxygen might have been tied up in forming rock sediments such as hematite, had it not been for the oxygen released by those early bacteria and algae.

Like to find some microfossils for yourself? The recommended procedure is as follows: Take a piece of limestone. Chisel it into 1-inch squares. Divide one of these squares into two parts. Crush one part as finely as possible. (The other half is kept as a reference piece.) Soak the crushed limestone for a few hours in cold water. Dry it on a hot plate, and sieve it through a fine wire mesh. Whatever passes through the mesh is, if you are lucky, the fossil-bearing grains of limestone. If you are not lucky, try the same recipe on another square of your limestone. And remember that one of the most important pieces of equipment a micropaleontologist can possess is patience.

– Ann Gill

Blue-green algae, fossils two billion years old, from Lake Superior rocks, resemble algae living today.



SCRAPIE—

The Smallest Killer

FOR YEARS, English shepherds grimly watched a disease known as *scrapie* (scrape-y) whittle down their flocks. The name comes from the way an afflicted sheep scrapes against fences and trees, tearing off patches of fleece. Gradually, the sheep loses coordination. It becomes a trembling wreck, and dies.

Veterinary scientists sought the cause of the baffling illness without success. Seeing the sheep's nervous degeneration, they were reminded of the dread human illness *multiple sclerosis,* which destroys the human nervous system. Its cause? A mystery.

Similarly, researchers noted a likeness to *kuru* — a strange, deadly disease that afflicts a tribe of New Guinea cannibals who eat the brains of their dead. These human brain-eaters often come to a trembling death like scrapie-infected sheep. Cause of kuru? Unknown.

Over the years, investigators tried transmitting scrapie from sick to healthy sheep. Why? Researchers saw definite indications that the disease might be hereditary. For instance, if a dam (mother sheep) dies of scrapie, chances are strong its offspring will die of it, too. Chances are so strong, in fact, that some researchers figured the disease could be the result solely of a "defective gene" that is passed from a parent sheep to its young.

Others, though, doubted that a defective gene was the sole cause of the disease. Thus, in the 1930's, French researchers J. Cuille and P. L. Chelle tried to transmit scrapie to healthy sheep by means of injections of a scrapie serum taken from the brains and spines of trembling sheep.

Of the nine sheep injected with scrapie serum, just two came down with the tremors. And they fell sick 24 months later. Thus, there was no way of telling whether the two sheep would have contracted scrapie without the inoculations — say, for hereditary reasons. After all, seven inoculated sheep remained in good health.

Then a misfortune in Scotland proved a happy accident for scrapie researchers. Scots flocks had been inoculated with a vaccine against another common sheep disease, "louping-foot." Scotland's sheep rarely contracted scrapie, but after the "louping-foot" vaccinations scrapie suddenly broke out across the entire country!

No history of scrapie existed in Scotland — none to speak of, anyway. Why had an epidemic abruptly struck? The Scots were puzzled.

Investigators discovered that the Scots sheep that caught scrapie received inoculations from a single batch

The ram and dam have scraped off huge chunks of their fleece. Scraping against fences, and uncontrolled trembling are symptoms of mysterious nervous disorder of sheep known as scrapie.
All photos from Dr. Iain H. Pattison, courtesy *Science Journal*

of "louping-foot" vaccine. By digging through records, the sleuths found that this batch was prepared from the brains of yearling sheep. Eight of the yearlings were born of dams that later died of scrapie!

Now scientists were convinced that scrapie was transmissible. Since heredity cannot be transferred by inoculation, some microorganism or other disease agent must be at the root of the illness.

French researchers Cuille and Chelle went back to work. In 1939, they successfully transferred scrapie from sheep to goats by means of injections! Here was certain proof of a disease agent!

World War II halted scrapie research. But in 1954, Dr. Iain H. Pattison, of Great Britain's Institute for Research on Animal Diseases, renewed the quest.

Dr. Pattison inoculated 12 goats with scrapie serum drawn from diseased sheep. Results? Within 24 months, all twelve goats contracted scrapie.

But the strangest chapter in the story had just begun. Reseacher Pattison reports: "As we became more familiar with scrapie in the goat, there was an interesting development that had far-reaching consequences. We noticed that . . . two distinct [types of scrapie] developed in the goats. We called these . . . 'drowsy,' in which profound dullness was the predominant sign, and 'scratching,' in which there was marked itchiness. . . ."

Thus, in goats, the scrapie agent divided into two distinct diseases. Each could be transmitted to healthy animals, suggesting that two strains of microorganisms now existed!

In 1960, British researcher R. L. Chandler gave scrapie inoculations to mice. They contracted the disease. And in the years since, the disorder has been transmitted to rats and hamsters.

"During all these transfers," Dr. Pattison recalls, "one question was uppermost in the minds of all investigators: What was the nature of the scrapie agent?"

As far back as 1938, researchers suspected a virus. Why? The French poured scrapie serum into a special filter. Its fine pores trapped any particle larger than viruses. Afterwards, they inoculated a goat with the filtrated serum! Result? The goat came down with scrapie. Obviously, the disease agent was small enough to slip through the tiny, viral-size pores of the filter. What else could it be, then, but a virus?

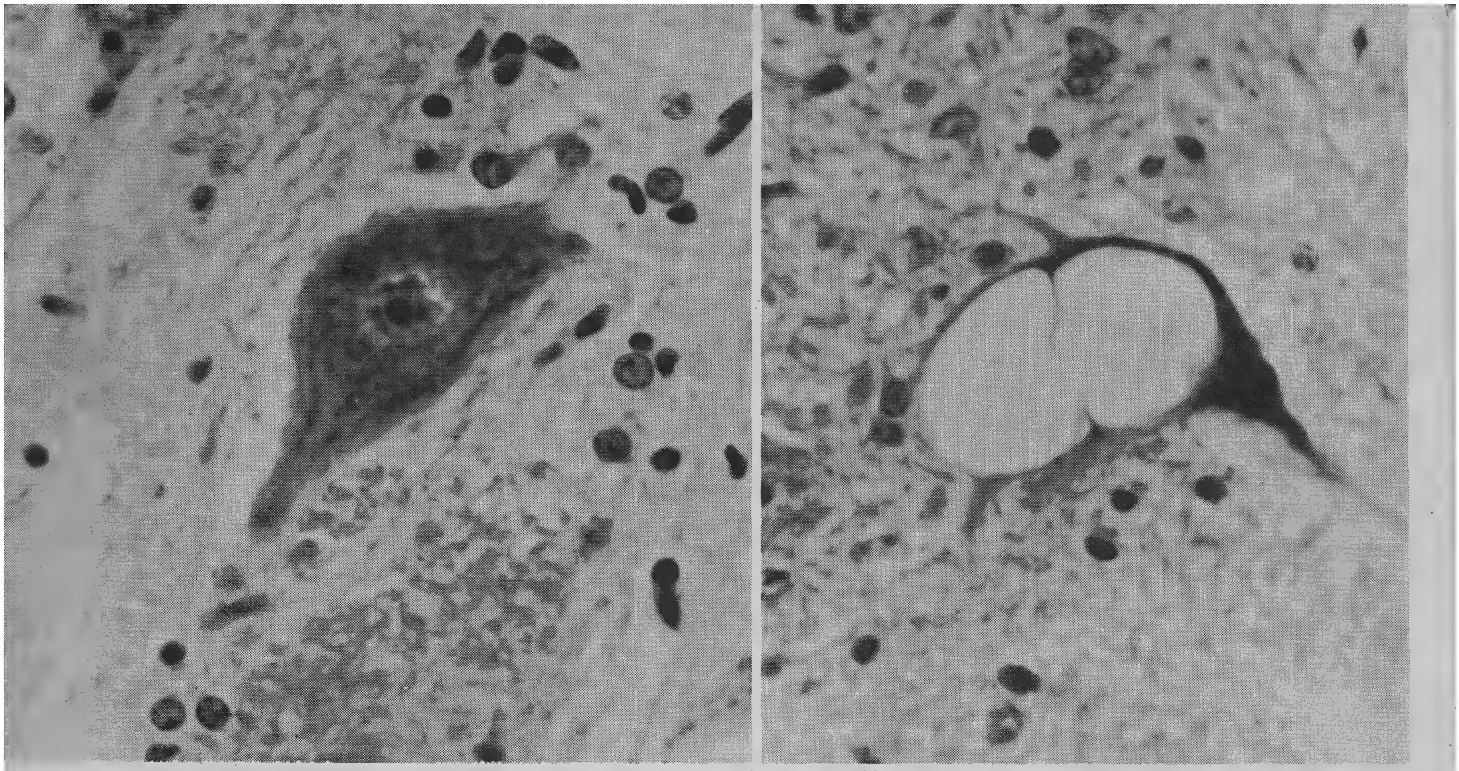
Recently, researcher Pattison tried to shackle the elusive virus. But under the powerful electron microscope, scrapie tissues gave no sign of viral intruders. Supermagnification revealed no particle or microorganism of any consistent shape.

Dr. Pattison was aware that humans, sheep, and other creatures produce specific antibodies against given viruses. Thus he sought viral antibody "fingerprints" in the blood serum of scrapie-infected animals. He could find none, however.

Bewildered, he set out to kill the mystery agent by methods that are sure-fire against all known viruses.

Continued on next page

Transmitted to mice, scrapie causes abnormal development of hindquarters. Disease has also been given to goats, hamsters.



Normal (left) and scrapie-infected (right) nerve cells are seen under powerful magnification. Note dark nucleus in normal cell. Infected cell is changed by disease into a fluid-filled cavity.

Scrapie *continued*

He blasted scrapie tissue with massive doses of ultraviolet radiation. But the irradiated tissues transmitted the disorder to new animals. Next, he "pickled" scrapie tissue in potent chemicals that spell death to viruses. But when he injected "pickled" scrapie brain tissue into healthy animals, they became infected. Thus the active agent either had "lived through" such treatment, or isn't alive at all!

One more time, Dr. Pattison tried to set a trap for the mystery agent. He contrived an ultra-ultra-fine, membranous filter, its pores a sub-submicroscopic 2.4 millimicrons in diameter (a millimicron is just one millionth of a millimeter). Six times he passed scrapie serum, with excruciating slowness, through the super filter. Each time, he injected healthy animals with some of the filtrated fluid. Astonishingly, four of the test animals caught scrapie! In other words, in two-thirds of the trials the active agent had "wriggled" through the near-nonexistent pores to reproduce the disease again!

Says Dr. Pattison: "This was incredible. It meant that, at a conservative estimate, the scrapie agent must be something less than half the size of the smallest known virus!"

Could the scrapie agent be a living organism? Scientists balk at the notion of complete living creatures on so tiny a scale.

In fact, Dr. Pattison and his colleagues doubt that the scrapie agent is "alive" in any traditional sense. Dr. Pattison suggests that the tiny agent may be a "basic protein" similar to protein molecules identified in the cell nucleus. These proteins are known as *histones*. Their role in the nucleus is still a mystery.

Dr. Pattison speculates that the scrapie agent may resemble a special histone. Say it slips into the nucleus of a nerve or brain cell. Because of the agent's close resemblance to basic proteins in the nucleus, the cell is tricked. It manufactures large numbers of exact copies. As with viral infections, the cell soon becomes "overcrowded" and the cell wall ruptures. When rupture occurs, the wandering agents are released to slip into more cells.

Perhaps a similar protein molecule lies behind kuru and multiple sclerosis. Dr. Pattison suspects some cancers may be related kin, too. Why? Pieces of brain tissue, from animals killed in advanced stages of scrapie, were placed in test tubes. Although normal brain cells usually die within two weeks under such circumstances, the scrapie-infected cells continued growing. Furthermore, Dr. Pattison observed them *dividing*, whereas normal brain cells *don't divide!* Thus he believes scrapie cells could have some mysterious growth mechanism like that of cancerous cells.

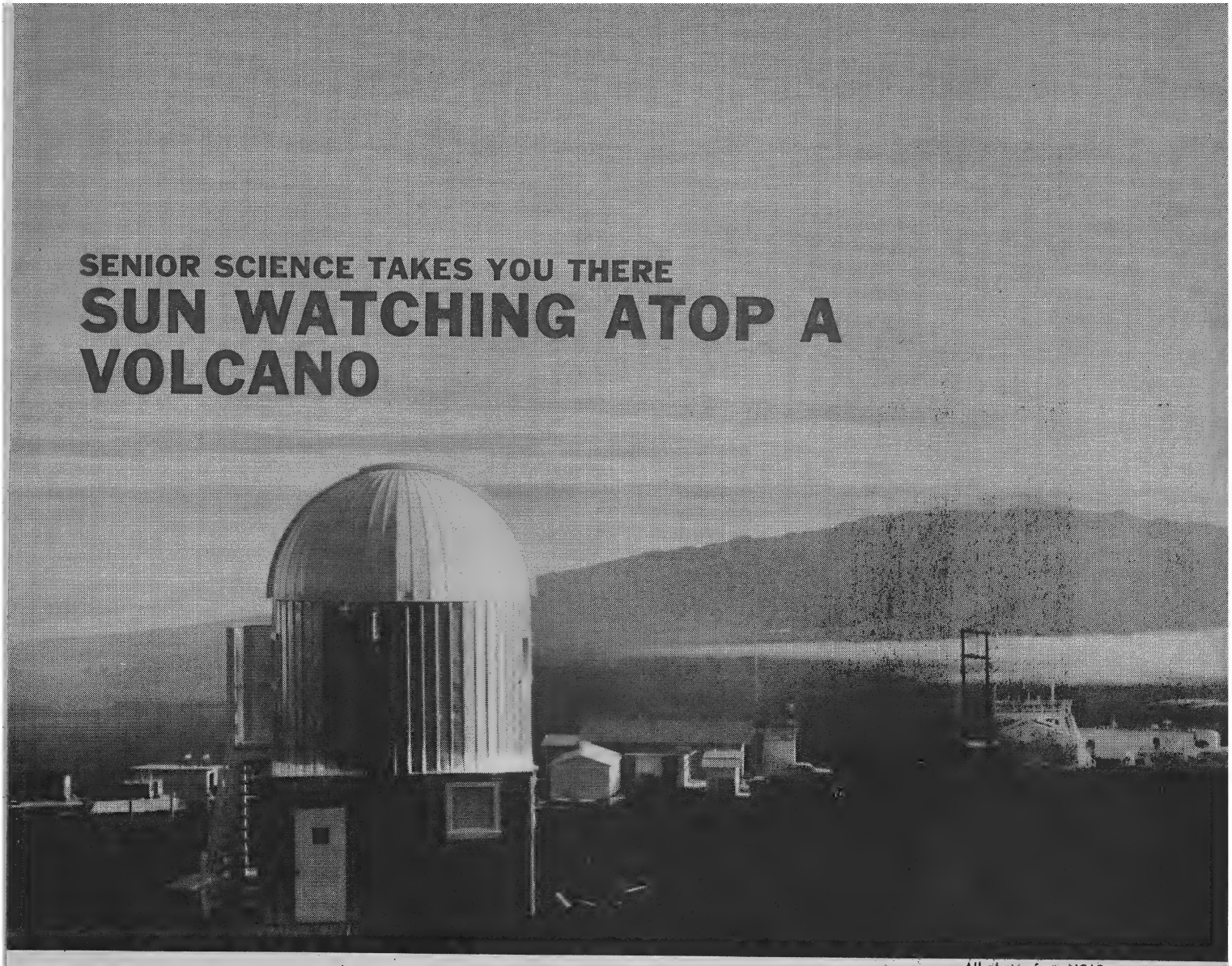
Dr. Pattison and other researchers are now pressing full speed ahead on scrapie research. Their investigations have already reached far beyond the sheep pastures where the long and amazing search originated. One troubling question: Since vaccines are usually made from preparations of *dead* viruses, could vaccine be prepared from a basic protein that can't be killed or deactivated? Does this question have dark significance for multiple sclerosis and cancer?

Only time will tell. A disease of sheep may one day provide a breakthrough in human medicine.

— JOHN SPEICHER

SENIOR SCIENCE TAKES YOU THERE

SUN WATCHING ATOP A VOLCANO



All photos from NCAR

ONE OF THE WORLD'S smallest professional observatories, on the world's biggest mountain – that's a thumbnail description of the Mauna Loa Solar Observatory, operated by the High Altitude Observatory of the National Center for Atmospheric Research (NCAR).

The mountain is Mauna Loa, an intermittently active volcano. It is one of five volcanic mountains that forms the island of Hawaii.

The observatory is a small, two-story wooden building topped by a prefabricated metal dome. Inside the dome is a special telescope called the *koronameter*. The observatory's two full-time staff members, Richard Hansen and Charles Garcia, use the koronameter to study the sun.

Man's first real scientific insight into the nature of the sun and its planets came nearly 2,500 years ago. In 450 B.C., the Greek philosopher Anaxagoras proclaimed that the sun is a red-hot stone, and that it causes the Earth and moon to shine by reflected light.

Although Anaxagoras was right about the reflected light, modern astronomers have found that the sun is not a stone, but a sphere of gas 864,000 miles in diameter. The sun's mass is some 330,000 times greater than the Earth's.

The sun is a giant atomic furnace. Near its center, where energy is generated by nuclear fusion, the temperature is about 25 million degrees Fahrenheit. The energy takes about eight minutes to travel from the sun's surface to the Earth, about 93 million miles away.

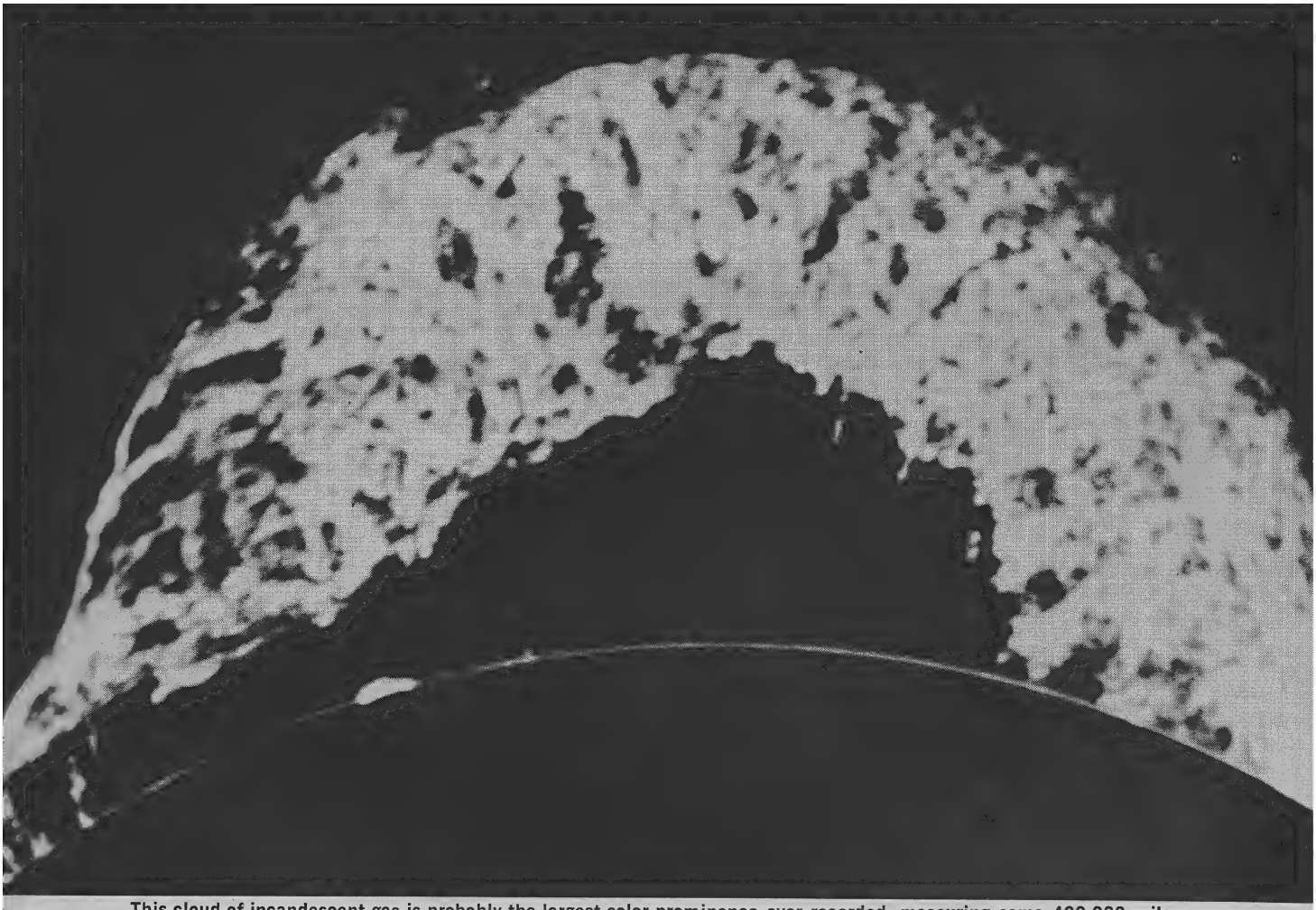
Above: Atop Hawaiian volcano, this domed structure houses a koronameter, used to observe parts of the sun's corona.

Less than a billionth of the sun's total energy falls on the Earth. But the solar energy that does reach our planet in a single week is greater than the total energy of all the fuel that man has ever burned.

Astronomers have discovered several different kinds of activity on the sun and in its thin, luminous outer atmosphere – the solar corona. Sunspots were discovered in 1611 by Galileo, using the world's first astronomical telescope. They are large splotches on the face of the sun. Sunspots increase and decrease in number and size regularly, following an 11-year cycle. Sunspot activity was low in 1964 and 1966, and is expected to be high around 1969.

Irregularly shaped clouds of glowing gas known as solar prominences often appear in the corona. They sometimes

Continued on next page



This cloud of incandescent gas is probably the largest solar prominence ever recorded, measuring some 400,000 miles.

Senior Science Takes You There *continued*

lie quietly and sometimes stream out into space at speeds as high as 100 miles per second.

Solar flares shoot out suddenly from sunspot regions on the face of the sun. They produce electromagnetic radiation that reaches the Earth in about eight minutes. When it reaches the Earth's upper atmosphere, this radiation can cause a blackout in radio communications.

Solar flares also produce clouds of electrically charged gases, which take from an hour to a few days to reach the Earth. These gases cause the aurora borealis, or northern lights. They can also produce radio disturbances and changes in the Earth's magnetic field. Some scientists believe that they can also strengthen storm centers and produce other changes in our weather.

The corona is the luminous halo that we see around the sun during a total eclipse, when the moon hides the face of the sun. Until 1930, eclipses provided the only chance for astronomers to observe the corona. At other times, the flood of light from the face of the sun drowned out the relatively dim corona.

But in 1930, Bernard Lyot, a French astronomer, invented an "eclipse-making" telescope called the coronagraph. This telescope uses a metal disc to create an artificial eclipse, and employs a system of lenses and apertures to cut down the scattered sunlight that might spoil its effectiveness.

Scientists in the United States have studied the sun with the coronagraph since 1940. In the summer of that year, a young Harvard University graduate student named Walter Orr Roberts came to Colorado. He set up the Western Hemisphere's first coronagraph at the little town of Climax, high in the Rocky Mountains. This location, at an elevation of more than 11,000 feet, was chosen because the coronagraph cannot operate effectively unless it is used where the air is thin, clear, and dry. Dust, moisture, and even air molecules scatter sunlight and interfere with the coronagraph's artificial eclipse.

Dr. Roberts is now director of the National Center for Atmospheric Research (NCAR), in Boulder, Colorado. The Climax observing station is operated by the High Altitude Observatory of NCAR.

We know now why solar observatories are built on high mountains. But why was the Mauna Loa Observatory set on top of a Hawaiian volcano?

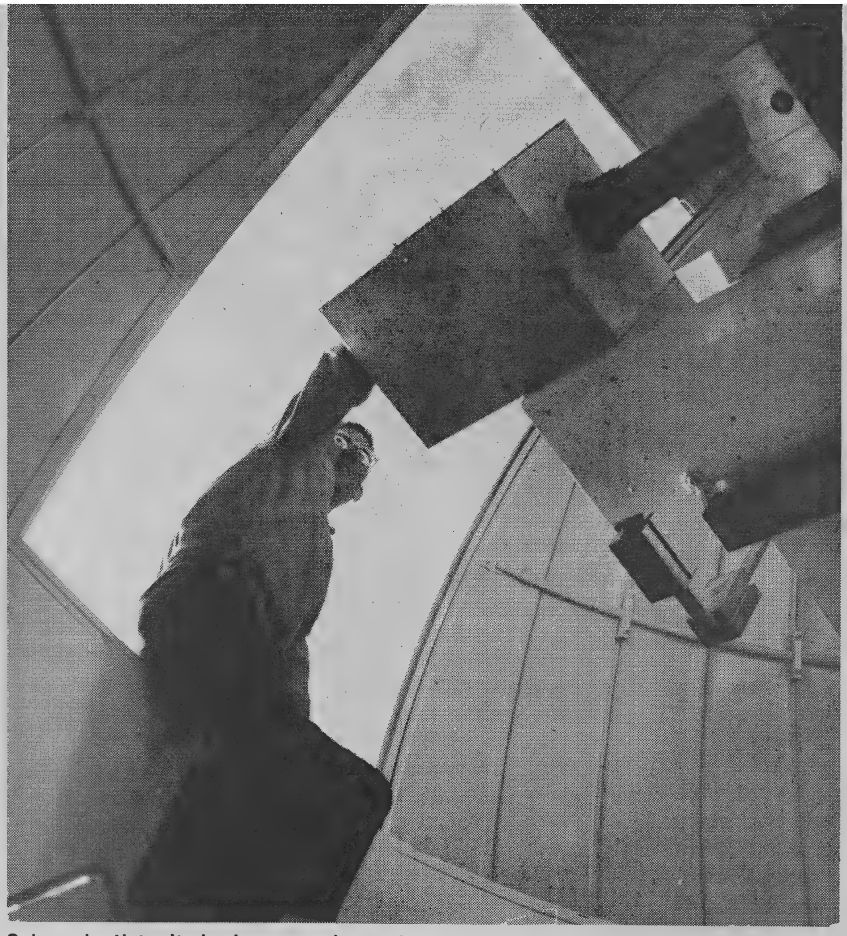
To answer that question, we must go back several years. In 1955, scientists at the High Altitude Observatory developed a special electronic coronagraph they called the K-coronameter, or koronameter. This instrument is used to observe the K-corona, the part of the solar corona that comes from light scattered by electrons.

Instead of making an instantaneous picture of the whole K-corona at once, the koronameter scans it a little at a time, building up its picture over a period of several hours. Thus it should

be used where the skies are clear for long periods at a time.

For several years, the koronameter was used at Climax. Conditions there were fairly good, but there were many generally clear days when clouds would pass over the sky from time to time, spoiling the koronameter observations.

In 1964, the koronameter was moved to Hawaii, where clear skies are often seen for long periods of time. The koronameter was first used at the University of Hawaii's Mees Solar Observatory on Haleakala, an extinct volcano on the Island of Maui. Richard Hansen, of the High Altitude Observatory staff, went to Hawaii to head a cooperative program of solar studies made by the High Altitude Observatory and the University of Hawaii.



Solar scientist sits in dome opening and adjusts the viewing end of the koronameter.

Volcanic Eruptions Little Threat

Although some valuable observations were made from Haleakala, the arrangements there had several drawbacks. One serious problem was caused by insects that gathered above the summit in such swarms that koronameter observations sometimes were completely impossible. Conditions were made worse by the dust stirred up by the construction of a "science city" of astronomical, atmospheric, satellite-tracking, and communications facilities on Haleakala.

In the fall of 1964, the High Altitude Observatory started looking around for a new observing site. They went to the Island of Hawaii, which Hawaiians call the "Big Island." They considered locations on Mauna Kea, an extinct volcano, and Mauna Loa, which is still active. It was decided that Mauna Loa offered clearer skies, because the barren lava of its upper slopes was practically dustless, and had no plants to shelter insects.

The Weather Bureau already had a station near the top of Mauna Loa, and arrangements were made to set up the new observatory there. Richard Hansen and Charles Garcia made the first observations from the Mauna Loa Observatory on December 12, 1965. Since then, they have conducted a regular observing program, with assistance from Mrs. Hansen in analyzing the data that they collect with the koronameter.

Mauna Loa is the world's largest active volcano and probably the largest single mountain of any sort on Earth, if you count the part of it that is beneath the ocean. It rises from a base 15,000 feet below the surface of the Pacific to a summit 13,680 feet above it. It is about 60 miles long and 30 miles wide, with a total volume of about 10,000 cubic miles.

Mauna Loa is one of the Hawaiian volcanoes that is still active. It has erupted on an average of once every 3½ years for the past century, pouring out a total of more than 3½ billion cubic yards of lava during that period.

Why would anyone set up an observatory in such a precarious location? It's not quite as risky as it sounds.

In other parts of the world, people run for their lives when a volcano erupts. In Hawaii, they also run, but toward the volcano! People come from all directions to watch the show. Hawaiian eruptions are not explosive, and they begin with enough warning to allow people to get out of the way before the lava starts to flow.

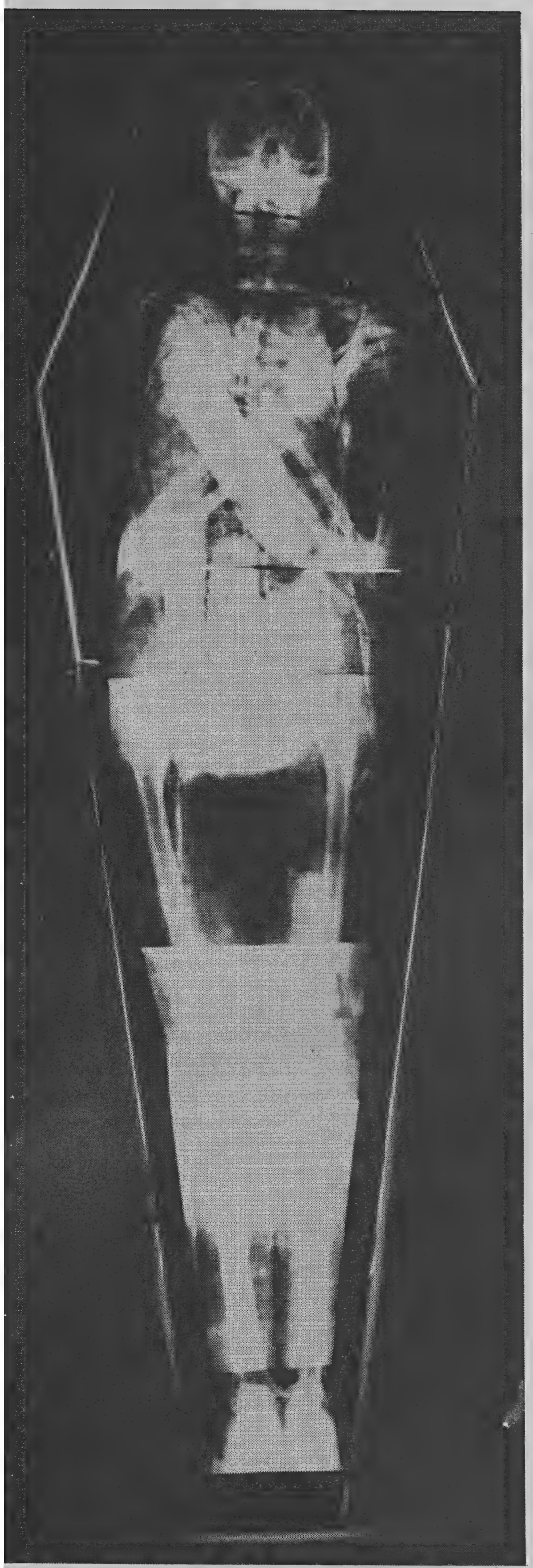
The typical Hawaiian volcanic eruption begins with a series of earthquakes. The earthquakes are followed by a bulging of the surface at the spot where the eruption is building up. The real fireworks begin with fountains of molten lava. Eventually, the lava begins to flow in large quantities, forming a lake or running down the mountainside in a river. The lava usually flows fairly slowly, although it may go as fast as 35 miles per hour. It is usually not hard to get out of the way of a lava flow, or even to outrun it, in a car or on foot.

The last eruption of Mauna Loa occurred in 1950. It lasted for 23 days and produced 600 million cubic yards of lava, which flower out to cover an area of 35 square miles.

An eruption would certainly be an inconvenience for the Mauna Loa Solar Observatory, but it probably wouldn't be a great danger to Mr. and Mrs. Hansen and Mr. Garcia. However, they are hoping that another eruption won't occur for a long time. It might destroy the observatory, and it certainly would fill the air with smoke and ashes. This would spoil the conditions that brought the High Altitude Observatory team to Mauna Loa in the first place. It would force them to stop observing for a while, or to start looking around for another mountaintop where the skies are clear and the air is clean.

— Henry Lansford

SCIENCE IN THE NEWS



UPI photo

Students of the Winona Hospital Radiological Technological School recently X-rayed an Egyptian girl who died 2,500 years ago. The full-size X-ray of the mummy is now on display at the Children's Museum at Indianapolis, Indiana.

New Controls for Wonder Drug

Exactly 20 years ago a "wonder drug," chloramphenicol, appeared on the U.S. market. Thousands of users gulped it down for ailments ranging from serious cases of typhoid fever to mild, common colds.

In 1952, warnings were sounded that the "wonder drug" might have side effects that were worse than the disease it was supposed to cure. Dr. William Damshek of Mt. Sinai School of Medicine, in New York City, an authority on blood diseases, said that chloramphenicol caused pernicious anemia. This is a rare blood disease that destroys blood cells in bone marrow.

In spite of this and other warnings, doctors are prescribing chloramphenicol at such a rate that 3.5 million Americans will gulp the drug this year. Last January, five medical experts told a Senate committee that nine out of every ten people using the drug use it needlessly. The Food and Drug Administration, alarmed at the number of users, may call for tighter prescription requirements. Dr. Herbert L. Ley, Jr., FDA director, says that the FDA may even send warning letters on the use of chloramphenicol to each doctor in the U.S.

Polar Flip-flop

Some distressing news for time travelers: Don't trust a magnetic compass. It may not show the right direction. Why not? The Earth's magnetic field reverses itself about three times every million years. The last time this happened was about 700 thousand years ago.

What's happening to the Earth's magnetic field today? For the past 2,000 years or so, it has been getting weaker. In a recent announcement, Dr. K. L. McDonald of the Environmental Science Services Administration predicted that, at its present rate of decay, the Earth's magnetic field will be about zero in the year 3991. He also predicted that large amounts of cosmic and solar radiation will get through to the Earth's surface in the preceding 500 years. Why? The strength of the magnetic field will be too weak to do its usual job of shielding the Earth from such radiation.

Is there cause for alarm? Possibly. But according to the calculations of earth scientists and biologists, the increase in radiation would be only about 25 per cent above the present level. Not enough to really worry about, they say.

Nibbling at the Forest's Fringe

As Congress continues to delay its decision on the proposed redwoods national park, two California redwood lumber companies have announced some action of their own. One company has decided to log out an area of redwoods that borders the southwest boundary of the proposed park.

The Sierra Club, which has been championing the cause of a redwoods national park, had hoped the companies would leave a shield of redwoods between the park boundaries and lumbering land. The company says that the contours of the land will not permit it to leave a fringe of trees along the area it intends to log. They are, however, not going to log within the borders of the proposed park.

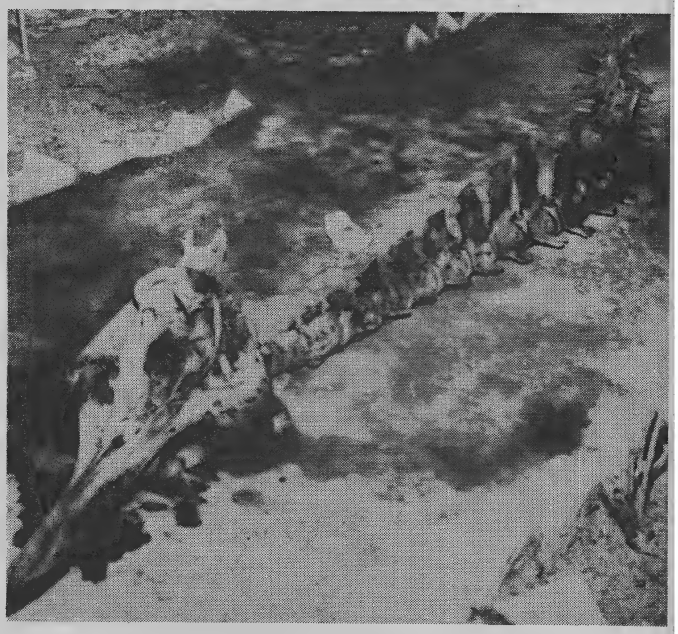
Arctic Adventure

Four brave Englishmen are beginning a 3,500-mile trek across the frozen wastes of the Arctic Ocean from North America to Europe. When they leave Barrow, Alaska, they will not see land again until more than a year later, when they reach Spitzbergen Island, Norway.

If the trip goes according to schedule, it will have five stages. From now until next June, the men will move steadily across the Arctic. Next summer, they and their dogs will spend months riding on a huge ice floe. When the ocean again freezes solidly, the men will travel for six weeks before the onset of almost complete darkness in late fall. With the return of light, they hope to break camp and dash south to Spitzbergen.

Mush! British trans-Arctic expedition team warms up for cold trip by taking an overnight hike. Soon team will leave Barrow, Alaska, for a 16-month, 3,500-mile trek to Spitzbergen, Norway.
UPI photo

A forest of limestone stalactites is growing in a room under Lincoln Memorial in Washington. Take them out? Not at all. Geologists are having too much fun studying them.
UPI photo



Sicilian beachcombers got big, bony haul. Eighteen-foot-long skeleton is thought to be that of a prehistoric reptile. It was washed ashore on Sicilian west coast.
Wide World photo

Target date for their arrival: June 21, 1969.

Wally Herbert, the expedition leader, compares the journey to the conquest of a "horizontal Mount Everest." Accompanying him will be two scientists and a physician. All are experienced in the 60-below-zero temperatures and lashing blizzards of the Arctic.

The four adventurers will be supplied by seven air drops of food. The Royal Air Force will monitor their progress by radio. But if anything goes wrong they will have to rely on their own resources. It might be impossible for planes to land on the jagged sea ice.

Wasps to the Rescue!

Can a wasp beautify America?

Scientists are counting on a wasp imported from Europe to save our dwindling elm trees, gorgeous green monuments that once glorified thousands of U.S. communities. In recent decades, the trees have been hit by Dutch Elm Disease, to the dismay of citizens and naturalists.

Dutch Elm Disease is spread by the elm bark beetle. The beetle burrows through the bark to lay eggs in small chambers near the channels that carry the tree's life-sustaining sap. The beetles carry a fungus that remains inside the bark, where it grows and blocks the flow of sap. With its sap supply choked off, the elm slowly dies.

Recently, the U.S. Department of Agriculture's Dr. R. I. Sailer imported some 3,000 wasps from Europe, where they are credited with keeping elm disease down to a minimum. The female wasp deposits her eggs in the beetle's burrow. When the wasp larvae emerge, they eat the larger beetle larvae!

Millions of the wasps are now being bred for a nationwide Save-The-Elms campaign. Some scientists think the wasps will halt the advance of the beetles, the fungus, and the disease.

Other scientists worry. Suppose, they say, that after the new European wasps run out of beetles for meals, they switch over to helpful insects, such as those that pollinate fields and orchards?

Champions of the wasp point out that this hasn't been a problem in Europe, where the beauty of the elm is still counted a blessing, as it was yesterday in America.

PROJECT POINTERS

Plant Environments

CHARACTERISTIC PLANTS serve as indicators of life zones or belts. If you live near the mountains, you probably have noticed the changes in vegetation and associated animal life as the altitude changes. If you live near the sea coast, you may know that characteristic animals of the tidal pools are not found in deeper water. Reading about marine collecting or (if you're lucky) talking with skin divers will acquaint you with the life zones in the ocean. Fresh water, the side of a mountain, a marshy pond – each has its own characteristic life.

Make a sketch or map of the plant zones around the nearest body of water. A cross-section will show how plants invade or infiltrate a pond. Eventually, living plants and their organic debris choke up most small bodies of water. You can probably find an old resident of your area who remembers bodies of water where now little or no water remains.

Man, too, must be taken into account as a "geological force." The building of reservoirs, the lowering of continental water tables, the occupation of large areas by buildings and streets – these are only a few of the ways that man changes ecological and geographical interrelationships.

Looking at Lake Life

A firsthand study of lake ecology might prompt you to try collecting the organisms of a *food chain*. One example of a food chain is shown in Figure 1.

A warm, shallow pond is an ideal "climate" for plant life. Plenty of water, sunshine, and warm temperatures aid rapid plant growth, food production, and reproduction. Investigate a marsh or swamp crowded with cattails, or a sluggish stream or pool with duckweed. You can record your observations in a "cross-section" sketch like Figure 2. Underwater, you'll find a myriad of green algae forms. Animal life dependent on such forms, particularly on microscopic plants, can grow profusely. (An excellent way to understand small life forms is to sketch aquatic plants and animals under the microscope.) Larger animal life which lives on protozoans (microscopic animals) can flourish and multiply in a pond.

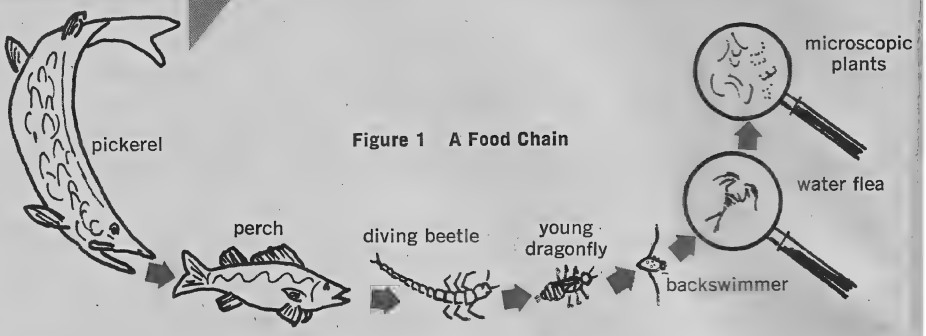


Figure 1 A Food Chain

Water Plants

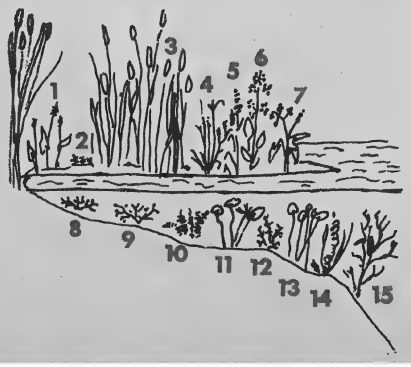
Fresh-water algae occur in many forms. Filamentous green algae such as spirogyra are the best-known. The single cells, called diatoms, are generally rather colorless. They occur in many forms. They make brook beds and water weeds golden brown. Marine algae tend to be reddish-brown rather than green. If you live near the seashore, you may enjoy collecting and preserving seaweed, especially the filamentous or branched forms, by mounting them on paper. To do this, first float the seaweed in a shallow pan. Float white drawing paper under the seaweed. Then separate the strands, center on the paper, and drain off the water. The gelatin in the seaweed makes it adhere to the paper as it dries.

Water plants must live near enough to the surface to receive ample light. They need light to make food. Cattails have their "feet" in the water and their leaves in the air. Duckweed and giant kelp float freely on the surface. Water lilies and arrowroot have submerged stems, and leaves at the surface.

Figure 2

Plant Distribution in a Pond

KEY: (1) pickerel weed; (2) Polygonum; (3) cattails; (4) bulrush; (5) burreed; (6) water plantain; (7) arrowhead. The following three are submerged plants: (8) Riccia; (9) bladderwort; (10) water milfoil. The remaining five are all floating-leaved plants: (11) lily pads; (12) hornwort; (13) spatterdocks; (14) eelgrass; (15) pondweed.



Waterfall Fauna

A typical distribution of life in a waterfall is related to the water current: water pennies or young beetles on the underside of rocks in the swiftest current; case-bearing caddis worms, midge and beetle larvae clinging to water mosses growing just under a miniature waterfall; a phoebe sitting on a branch above waiting for winged adult forms to emerge; trout fingerlings in the fast water; water striders in the back eddies; a frog hiding beside a rock, etc.

Liverworts and Mosses

Mats or clusters of small, green, shade-loving plants called liverworts are found at the edge of streams. Because they have no water storage cells, they lose water very quickly and cannot stand drying out any better than the skin of a frog. To keep liverworts alive in terrarium on a rock, the liverwort is spread half submerged in water. You will find that mosses can grow farther away from water. Sphagnums and bog mosses grow best when water-soaked.

Soil Studies

What kind of plant and animal communities exist in soil?

With a spade, remove a one-foot block of rich garden soil, or soil from the woods or a meadow. Examine the soil for earthworms, sow bugs, slugs, insect larvae and pupae, millipedes, and other living things. Photograph the living things and prepare a population report.

Transfer small samples of soil into dishes containing a little water. Then place a bit of soil in a drop of water on a microscope slide. Using high power, search for fungi, small worms, and large bacteria. Staining with methylene blue will help you locate some of the larger soil bacteria.

— ALEXANDER JOSEPH

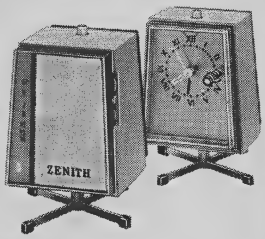
MAKE THE SCENE WITH A ZENITH!

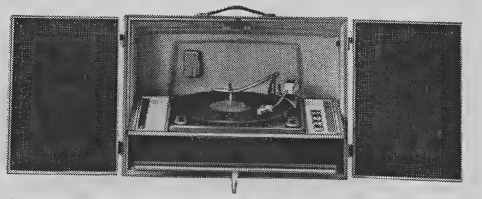
It's great the way a Zenith turns on the fun. Great the way it can keep up with the crowd, too, no matter how wild the scene. That's because every Zenith is built better to last years and years longer.

Powerful, personal-size transistor radio with a big, swinging sound. Plays up to 250 hours on flashlight batteries. *Royal 35.*

The world's finest performing shirt-pocket radio. Includes carry case, earphone, batteries. *Royal 14-G.*

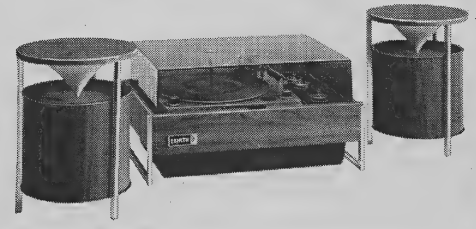
It's a clock! It's a radio! Groovy little back-to-back Zenith turns on a tiny swivel. *The Aristocrat, Model Y280.*





Zenith solid state portable stereo with twin speaker units that can be placed up to 20 feet apart. Exclusive Micro-Touch® 2G Tone Arm. Four speed changer. *The Melody Maker, Model X554.*

Zenith battery-operated phono with exclusive Bandshell design for dynamic sound. Plays on household current, too. Solid state amplifier. Four speed changer. *The Sportabout, Model X512.*



Zenith's exclusive "Circle of Sound" Stereo. Surrounds you with perfectly balanced stereo sound no matter where you sit in the room. Solid state. *The Moderne, Model Y565*

BEST YEAR YET TO GET THE BEST

FIFTIETH ANNIVERSARY 1918 50 1968 50 YEARS OF LEADERSHIP THROUGH QUALITY

ZENITH®

The quality goes in before the name goes on

SCOREBOARD

How well have you read your *Senior Science*? Answers to questions with no asterisks may be gleaned directly from the articles. Answers to questions with an asterisk (*) require fusing the facts in the articles with those learned in the classroom or from your reading. Answers are in the SCOREKEEPER on page 28.

I. Senior Science Takes You There

_____1. The sun's corona is visible only at the time of a solar eclipse.
_____2. It takes light about eight minutes to travel from the sun's surface to the Earth.
_____3. The existence of sunspots was known to the ancient Greeks.
_____4. Solar flares are followed by the emission of electrons and protons, which, when they arrive at the Earth, cause magnetic storms.
_____*5. The surface area of the sun is more than 10,000 times that of the Earth.

II. Scrapie

_____1. The agent which causes scrapie can be seen only in the most powerful electron microscopes.
_____2. Scientists are agreed that the agent that causes scrapie is a living organism.
_____3. The histones are a group of proteins whose function in the cell nucleus is not known.
_____4. As a person grows from infancy to adulthood, the number of nerve tissue cells in his body remains constant.
_____5. Scientists have developed a vaccine against the causative agent of scrapie.
_____*6. Unlike the viruses, the causative agent of scrapie does not stimulate the production of antibodies in the host.

III. Microfossils

_____1. Foraminifera belong to the class of animals known as protozoa.
_____2. Some of the Forams spend their entire lives in the photic ocean zone, while others are born and live in the ocean bottom.
_____3. Evidence from the study of fossil Foram shells indicates that the next glacial period will begin within the next 2,000 years.
_____*4. Some of the oldest rocks discovered on the Earth's surface have been estimated to be over three billion years old.
_____*5. Volcanic eruptions remove large quantities of oxygen from local areas.

IV. The Cellular Pendulum

_____1. Daily variations in bodily temperature follow a fixed 24-hour pattern rather than the activity pattern.
_____2. The action of all enzymes begins to slow down as the end products accumulate.
_____3. Energy must be supplied to induce glycolysis – the breakdown of complex sugars into simpler ones.
_____4. The high-frequency oscillations of a quartz crystal serve as a time standard for many laboratory clocks.
_____*5. The ability of certain compounds to fluoresce under ultraviolet makes such compounds useful as tracers in chemical and physiological reactions.

Going Beyond

"Isotopes are forms of the same element, such as oxygen, which have different atomic weights. In warm waters, Foram shells absorb the heavier isotopes of oxygen. In cold water, the shells take in the lighter oxygen."

When you read these sentences in the article on "Micropaleontology" in this issue of *Senior Science*, did you ask the question "Why"? If you didn't, you are missing half the fun. You are also not reading scientifically. How much do you know about isotopes and how they are separated? See if you can answer the following questions:

1. Ordinary hydrogen has an atomic weight of approximately one atomic mass unit ($_1H^1$). Heavy hydrogen weighs two ($_1H^2$). Can ordinary hydrogen be separated from heavy hydrogen by chemical means? Explain.

2. What significant physical difference between the two isotopes of hydrogen can be used to separate the isotopes?

3. As electrolysis of water is carried out, why are the water molecules which contain the heavy isotope of hydrogen less likely to be broken up than those that contain the more usual variety of hydrogen?

4. Why is it more difficult to separate uranium of isotopic mass 235 from uranium-238 than it is to separate hydrogen of mass 1 from hydrogen of mass 2? (Hint: What is the per cent difference in their weights?)

5. The separation of the fissionable uranium-235 from its more common isotope, uranium-238, is accomplished by the process of diffusion. Uranium hexafluoride (UF_6) is a gas. Explain how diffusion is used to separate the two isotopes of uranium.

6. Why is oxygen of isotopic mass 18 less likely to be absorbed by Forams which live in cold water than oxygen of atomic mass 16?

SCI-FUN

"It's almost impossible to believe that Shorty Potts and Rock Hudson are each made up of the same chemical content."

Send 30¢ now!

ALL NEW!

1968 MODEL CAR CATALOG!

176 BIG PAGES!

ORDER BY MAIL!

• THOUSANDS OF CARS • SLOT RACERS • PARTS • TOOLS • SUPPLIES •

SEND 30¢ (or 5 new 6¢ stamps) for YOUR COPY!

NEWSSTAND PRICE 60¢

auto world BOX 961 SCRANTON, PA.

I enclose 30c (or stamps). Send my 68 Catalog! SS

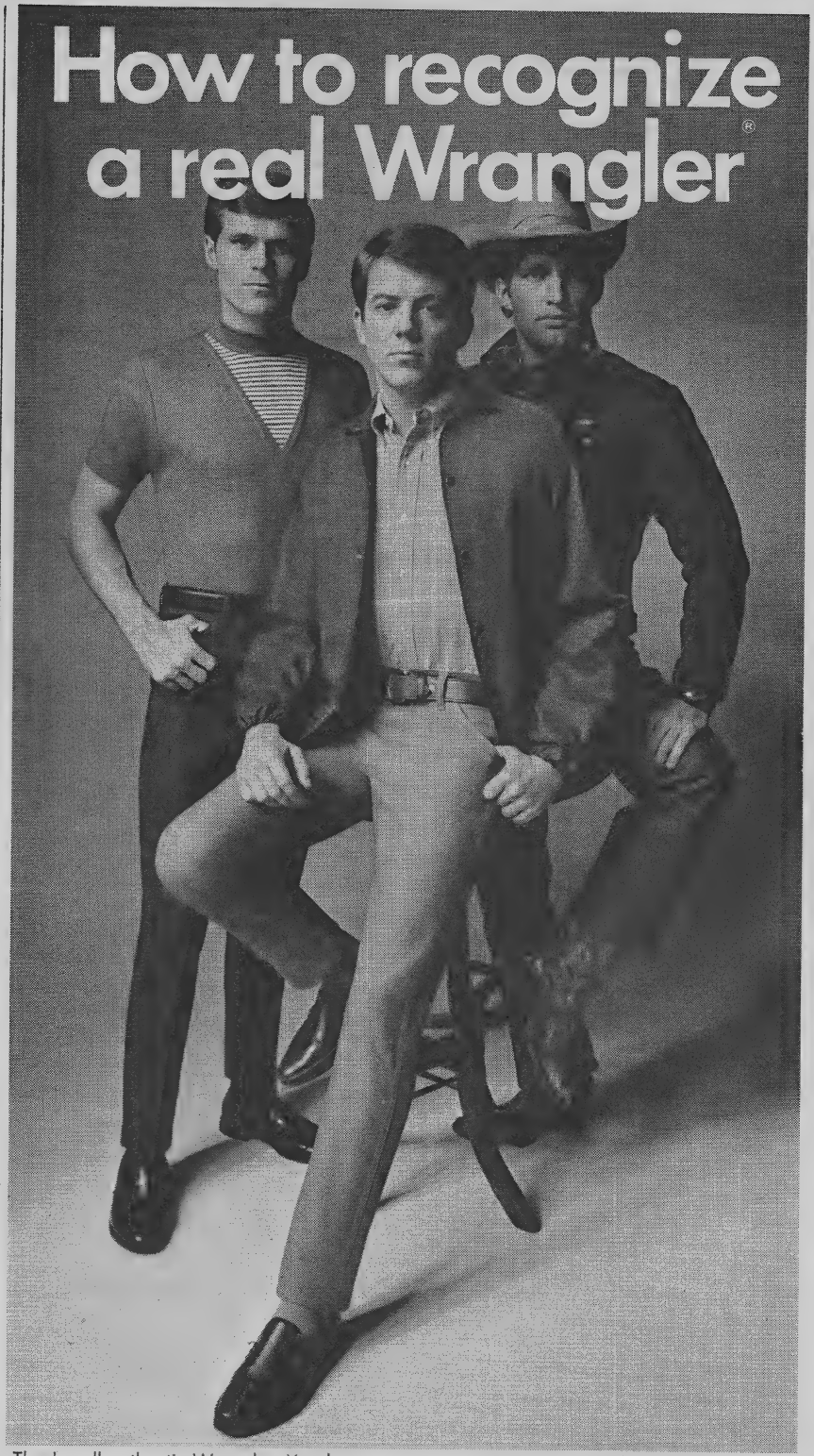
Name _____

Address _____

City _____

State _____ ZIP _____

How to recognize a real Wrangler®



They're all authentic Wrangler. You know you can spot our jeans a mile away. They've got a lean and easy way of fitting. The longer you wear them the better they look. And after a while, you'll be just as quick to recognize the other things Wrangler makes. Because they're made the same great way. Permanent press knit shirt and Hondo® Hog fast back slacks; washable, snap-front, water-repellent jacket; canvas duck jeans and permanent press ivy shirt. The group, from $3 to $6 each. Wrangler Sportswear, 350 Fifth Avenue, New York, N.Y. 10001.

©1968 BLUE BELL, INC. PRICES SLIGHTLY HIGHER IN THE WEST.

Wrangler® Sportswear

Wremember the "W" is silent!

STAN THE NEW MAN

Poor Stan Mikita. Scoring champ for three out of the last four years and triple-crown winner in 1966-67, he still plays in the shadows of teammate Bobby Hull—just as he did when they were teammates in high school.

STAN MIKITA must now know how Lou Gehrig felt back in the 1920's. Gehrig, a tremendous ballplayer, had to play second fiddle to his teammate, the one and only Babe Ruth. Mikita, a tremendous hockey player, has to play second fiddle to his teammate, the one and only Bobby Hull.

"Golden Bull" Bobby has that easy grace, that certain thing called "color," and that great "home run" shot. All of which makes him No. 1 with the fans. Poor Stan can only be No. 2. But, like Avis, he tries harder because of this. And there are experts who feel he's an even better all-around player than Hull. Mikita is all over the ice scrambling, darting, poke-checking, setting up teammates, and scoring.

You can't laugh away his record. Mikita has led the National Hockey League in scoring three out of the last four years. And as this is being written, he's making a strong bid for his fourth title.

What's more, Mikita is the only player in history to have won the triple crown in one year—the Lady Byng Trophy for sportsmanship, the Art Ross Trophy for scoring, and the Hart Trophy as the most valuable player.

Mikita won all this hardware in 1966-67. The tough one was the Lady Byng. What a turn-about this was for the 5-9, 165-pound, hard-faced "tough guy"! It was like Bonnie and Clyde throwing away their guns and joining the Salvation Army.

For eight years, Mikita had been called one of the dirtiest players in hockey. He had spent 755 minutes in the penalty box. Then, almost overnight, he changed. He realized that he couldn't help the Hawks from a "box" seat on the sidelines. So he cut out the rough stuff and went on to prove that nice guys can finish first.

In 1959-60 Stan logged 119 penalty minutes; last year he drew just 12 penalty minutes.

SHORT SHOTS

• The experts who make up the odds on the big league races don't dare show their faces in Boston. Those wild and wooly Red Sox fans would boil them in tar. The odds-makers had the nerve to pick Boston to finish *fifth*! What an insult to the team that won the flag in 1967!

Here's the way the odds-makers have doped the races for 1968:

American League	*National League*
1. Minnesota (2-1)	1. St. Louis (8-5)
2. Baltimore (5-2)	2. Pittsburgh (5-2)
3. Detroit (3-1)	3. San Francisco (3-1)
4. Chicago (5-1)	4. Chicago (4-1)
5. Boston (6-1)	5. Cincinnati (5-1)
6. California (8-1)	6. Philadelphia (6-1)
7. Cleveland (15-1)	7. Atlanta (8-1)
8. New York (50-1)	8. Los Angeles (15-1)
9. Washington (75-1)	9. Houston (75-1)
10. Oakland (100-1)	10. New York (200-1)

The experts' thinking is pretty plain. They think that the Red Sox "lucked" into the pennant last season, that the Sox pitching is too thin, and that Carl Yastrzemski can't possibly tear the league apart again. Minnesota, Baltimore, and Detroit, they feel, are better all-around teams, while the White Sox have that great pitching.

Don't argue with *me*. I'm not the wizard of odds. But I respect them. The odds-makers don't let their hearts get in the way of their heads. They weigh everything coldly and carefully. They make mistakes, but they're right more often than wrong.

The Red Sox have at least one big argument in their favor: If they were able to win the flag with Tony Conigliaro out for half the season, won't they be a whole lot tougher with Tony's booming bat in the lineup all year?

• Quick now, name the 10 greatest women athletes in the land. Tough, eh? Our gals rarely make the headlines, and it's tough to keep track of them.

Anyway, here are the 10 greatest girl athletes in the country, as chosen by Associated Press: (1) Billy Jean King, tennis; (2) Kathy Whitworth, golf; (3) Peggy Fleming, figure skating; (4) Nancy Greene, skiing; (5) Debbie Meyer, swimming; (6) Claudia Kolb, swimming; (7) Charlotte Cook, track; (8) Lt. Micki King, diving; (9) Catie Ball, swimming; and (10) Mildred Ignizzio, bowling.

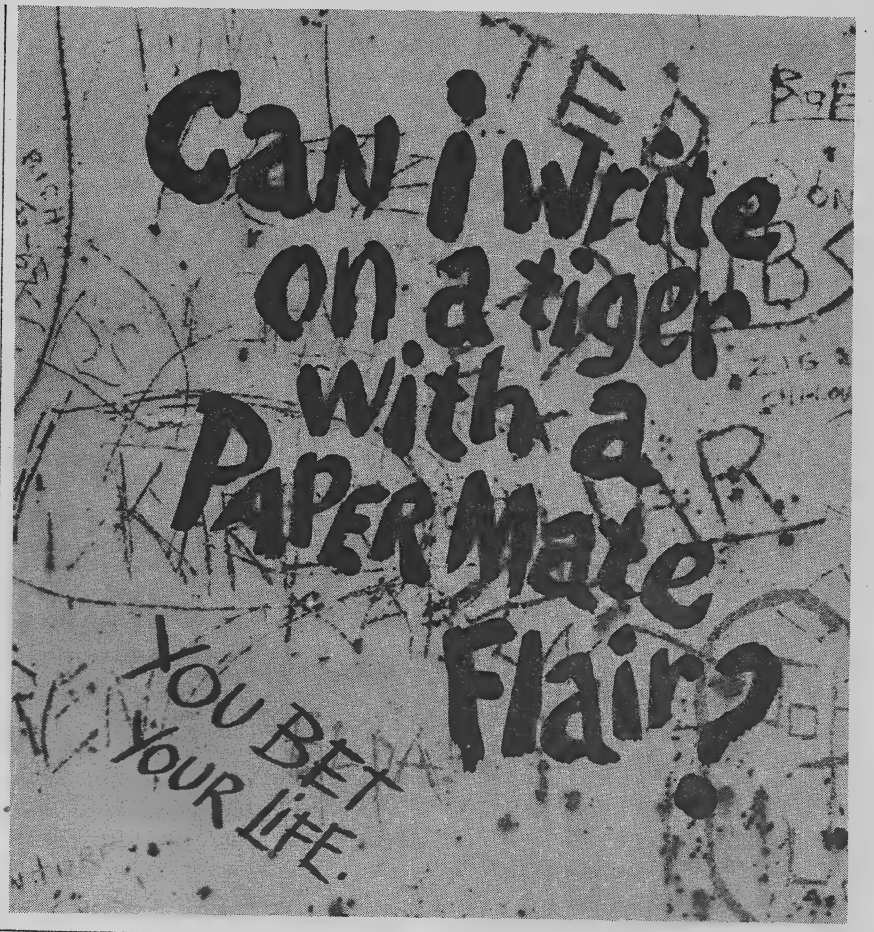
• Everyone made a big fuss over 14-year-old Janet Lynn of Rockford, Ill., when she won a place on our Olympic figure skating team. It *was* a great honor. It made her the youngest athlete on our Team. But it hardly set any record.

Youth was served more spectacularly in 1924, when Norway sent an *11-year-old* girl to the Olympics. That was Sonja Henie. The little round-faced girl cried her eyes out when she finished last. But from then on the Olympics became a "laughter" to her.

At the age of 15, she won the 1928 Olympics. At 19, she won the 1932 Olympics. And at 23, she won the 1936 Olympics. With no more worlds to conquer, she became a movie actress and then an ice-show queen. She was terrible at the first and fabulous at the second—and made millions of dollars at both.

—HERMAN L. MASIN, *Sports Editor*

FOLLOWING THE FILMS



DOCTOR FAUSTUS
(Columbia)

In 1588, a teenager named Christopher Marlowe wrote a play about a middle-aged German scholar who traded his soul to the devil for youth, knowledge, and power. The play was *Doctor Faustus*, and its "mighty lines" were praised by such prominent English poets as Ben Jonson. Until now, however, no movie-maker has put Marlowe's Elizabethan melodrama on film. We can thank Richard Burton (who co-directed with Nevill Coghill) and the members of England's Oxford University Dramatic Society for making this bold effort to bring Marlowe's work to movie audiences.

Onscreen, *Doctor Faustus* shows up as an interesting antique. Age has tarnished and flawed it, but under the dust there is something of value. Marlowe's lines are still powerful, and Burton's sonorous tones give them full value. The scene in which Faustus conjures up Mephistophilis (played by Andreas Teuber, the only American in the cast) is breathlessly unforgettable. So is Mephistophilis' answer to Faustus about the location of hell: "Why, this is hell — nor am I out of it . . ."

Marlowe's characterization of Faustus is interesting. He shows Faustus as rigid and unimaginative. For all his scholarly curiosity, the doctor does little with his dearly-bought youth and power. He wastes the brief 20 years Mephistophilis sells him performing conjuring tricks, roistering in taverns, investigating hallucinations — and, in one scene, childishly mocking a group of monks. Mephistophilis is shown as a weary but patient salesman, well aware how shoddy his goods are — but also aware of his customer's vulgar tastes. When Faustus grows bored and fretful, Mephistophilis soothes him by conjuring up phantoms of famous beauties such as Helen of Troy. All these glamorous ghosts are played by Elizabeth Taylor, but fortunately for Marlowe's poetry, she has nothing to do but look beautiful. In spite of her presence, Faustus discovers that the price of a deal with the devil is never right.

CUSTER OF THE WEST
(Cinerama)

General George Custer, that controversial hero of America's western frontier, is back, riding the wraparound Cinerama screen. This time he is portrayed by British actor Robert Shaw. But even Shaw (who gave such depth to his portrayal of the young Henry VIII in *A Man for All Seasons*) doesn't manage to tell us much about what made Custer tick. But this flawed characterization isn't Shaw's fault. The blame is about evenly divided between an inhibited script and the Cinerama process itself, which can't resist interrupting the story to show off in realistic shots of a train plunging downhill, a tree falling toward the audience, etc.

George Custer (1839-78) was the youngest general in the Union Army during the Civil War. His war record was spectacular and distinguished. After the Civil War he became acting commander of the Seventh Cavalry, whose duties included keeping the West safe for settlers and miners. Inevitably, this kind of police duty infringed on the rights of the Sioux and Cheyenne Indians, and this film indicates that Custer's sympathies were with the Indians. But history seems to indicate otherwise. After opening the Black Hills to gold-hunters, he doomed the Sioux and himself. He died fighting the Sioux at the battle of the Little Big Horn.

Death made Custer a popular American folk-hero. His controversial character can't be clarified by old-fashioned cavalry-versus-Indians like this film. It leaves out more interesting facts than it supplies. What about his court martial in 1867? What about the accusation leveled against him that he abandoned his men to certain death at the battle of the Washita in November of 1868? You won't find these facts in *Custer of the West*. Nor will you find any indication as to the character of Custer's wife, a part in which Mary Ure is completely wasted. The film-makers ignored the character of this brooding, fascinating woman who refused to admit her husband's faults and spent her life turning him into a legend.

— MARGARET RONAN

When you give the United Way you give to

NATIONAL URBAN LEAGUE
AMERICAN TEAMWORK WORKS

National Urban League

By CAROL RAY

Dear Carol: Why is it that my hands get more chapped than my friends'? I do the same things they do and am outside the same amount of time as they are. I'm using hand cream to soften my skin and it seems to have some effect. But I was just curious to know why I suffer from this problem more than they do.

A. How handy are you about the house? Do you wash dishes for your mother? Do you vacuum and dust? Do you help with the heavy cleaning? All these activities contribute to skin dryness and chapping. In fact, household chores rank third after blustery weather and indoor heating as a prime cause of dry skin on hands. Why? Because abrasion of the skin occurs when you scrub and rub. This abrasion hurts your skin and dries it out rapidly.

Every girl has her own individual "threshold" of dryness, and she progresses to it at her own rate of speed. Skin dryness occurs first wherever the skin is thinnest—and at this time of year, this means your hands. The next driest parts of your body are usually the tops of your feet, the backs of your heels, and your elbows.

Even though dry skin may look tough and feel rough, it is as absorbent as a blotter. That's why hand cream is effective—it penetrates to supply badly needed moisture and oil. (Another reason why hands get dry is that they have no oil glands at all on the backs and hardly any on the palms.)

Dear Carol: I just love the new bouncy hair styles. Can you tell me how to set my medium-length hair so it'll look like the curly coifs I see in the beauty magazines?

A. One of the most popular hair styles today goes back to the days of Shirley Temple. You have probably seen her soft, fluffed ringlets in the old movies shown on television. To set this coif, perfect for medium-length hair and an oval, oblong, or long face, use medium-size rollers and pincurls. Wind three rows of crown rollers vertically across your head to the left. Next, set the sides with two rollers turned toward your face. Three rows of rollers at the back of the head are then wound under to meet two rows of pincurls at the nape of the neck. When your hair is dry, flip the curls in place with your fingertips and gentle combing.

For a less-curled look ideal for a pear-shaped or oblong face, begin by parting your hair diagonally. Then wind front hair in medium-size rollers going diagonally away from the part on either side. At each ear, turn up one roller and top it with a pincurl toward your face. Crown and back hair are rolled under on a slight diagonal until rollers cover your whole head, excluding the bottom, which is set with crisscrossed bobbypins. When your hair is dry, brush it thoroughly to blend roller lines. Flip one side toward your face and make fingertip curls on the other side.

Dear Carol: I don't know why it is, but I perspire a lot. I use a deodorant, so there isn't any odor, but isn't there something I can do to stop the perspiration?

A. Yes. Using a deodorant every day will eliminate odor. Using a deodorant that contains an antiperspirant will eliminate odor *and* control perspiration. Apply it every day or night after your bath or shower. Cover the entire underarm area so that you get complete protection. It's also necessary to keep underarms free of hair, because hair traps perspiration and odor. After you shave, your skin may be slightly sensitive, so shave at night and wait eight hours—until the next morning—before using your antiperspirant.

"Here's Looking at You!" is planned to help make YOU the kind of person who presents an attractive appearance to others. Do you have questions you'd like to ask about your appearance? Girls—write to Carol Ray, Scholastic Magazines, 50 West 44th Street, New York, N.Y. 10036. Boys—write to Steve Daniels at the same address. Sorry, no answers by letter.

FREE with order TWO 5x7 ENLARGEMENTS
32 BILLFOLD PHOTOS (WALLET SIZE) $1.00 (25¢ handling)
2½ x 3½ photos on silk finish portrait paper. Send any photo or negative. 4 day in-plant service on 5 x 7's or smaller. Pictures guaranteed. Send cash, check or M. O. for $1.25 (64 for $2.25) One pose per order. SEND TODAY
GEPPERT'S STUDIO
add 25¢ for 1st class return 401 East 6th, Des Moines, Iowa 50309, Dept. 121

ANSWERS TO PUZZLE
(see page 32)

	C	A	P	A	C	I	T	O	R	S
R		F	I	L	M		U	H	F	S
E	M		N	S		I	B	M		O	O
S	U	N		O	N	C	E		O	F	L
I	D	E	A		A	E		H	I	F	I
S		O	M	A			P	A	L		D
T	B		P	A			F	M		M	S
A	L	A	S		D	C		S	L	I	T
N	A	P		B	I	A	S		I	C	A
C	B		R	O		T	I	M		A	T
E		B	A	A	L		V	H	F		E
	M	I	C	R	O	P	H	O	N	E	

SENIOR SCIENCE 5-H-66

For Further Reading

Microfossils—Clues to the Past

Jones, David J., *Introduction to Microfossils*, Harper & Bros., 1956.

Jahn, M. E. and Woolf, Daniel J., translators, *The Lying Stones of Dr. Johann Bartholomew Adam Beringer*, University of Calif. Press, 1963.

Cloud, P. E., Jr., "Significance of the Gunflint (Precambrian Microflora)," *Science*, Vol. 148, No. 3666.

Schopf, J. W. et al., "Electron Microscopy of Fossil Bacteria Two Billion Years Old," *Science*, Vol. 149, No. 3690.

Ericson, David B. and Wollin, Goesta, "Micropaleontology," *Sci. Am.*, July 1962.

Scorekeeper

(see page 24)

I. Mauna Loa Solar Observatory
1.F; 2.T; 3.F; 4.T; *5.T.

II. Scrapie
1.F; 2.F; 3.T; 4.T; 5.F; *6.T.

III. Microfossils
1.T; 2.F; 3.F; *4.T; *5.F.

IV. The Cellular Pendulum
1.F; 2.F; 3.F; 4.T; *5.T.

SWAP PHOTOS
Guaranteed High Quality Photos
Extra Fast In-plant Service
30 for $1.00 Wallet Size
Send 25c for handling & postage on all orders.
65 for $2 2 FREE Enlargements (Same Pose) with $2.00 order
2½ x 3½ in. wallet size on silk portrait paper. Send favorite snapshot, negative or portrait. (returned unharmed)
Gross Copy Co., Dept. 2366 4204 Troost, Kansas City, Mo.
2 FREE Enlargements
Your Friends Will love these Glamorous Photos

DISC-USSIONS

THE BEST OF THE NEW LPs

BY ROY HEMMING

with Robin McBride, Ed Coach, Buzz Royden

CLASSICAL ALBUM OF THE WEEK **Penderecki: Passion According to St. Luke—Soloists, Chorus, & Cracow Philharmonia under Henryk Czyz** [*Philips PHS2-901*]**—Soloists, Chorus, & Orchestra of Cologne Radio under Henryk Czyz** [*RCA Victrola VICS6015*]. Not since Stravinsky's *Rite of Spring* in 1913 has a major new musical composition had quite the critical impact in Europe of this *Passion* by Polish composer Penderecki (pronounced Pender*ets*kee)—with some critics calling it the greatest religious work of the century. Few listeners are likely to find it easy at first. It combines traditional and contemporary musical elements in a remarkably original way—yet all with a dramatic and emotional intensity that so little modern music ever achieves. The work is one that all serious music lovers should not miss. But which recording is not an easy decision, since the conductor and most of the soloists are the same in each. The Cologne Radio originally commissioned the *Passion* and premiered it in 1966—and RCA has wisely put this excellent 2-LP version on its budget Victrola label. The subsequent Cracow performance has a somewhat better chorus and narrator, and more cathedral-like sonics. Philips is matching RCA's budget-label competition by offering its 2-LP set for the price of 1 LP for a limited time only. The Philips LP has an added plus: inclusion of Penderecki's overpowering 9-minute *To the Victims of Hiroshima,* originally included in a splendid Philips LP of contemporary Polish music [*reviewed Nov. 2, 1967 issue*]. (R.H.)

Prokofieff: Piano Concerto No. 3; & Ravel: Piano Concerto in G—Martha Argerich, Claudio Abbado, Berlin Philharmonic [*Deutsche Grammophon 139349*]. Miss Argerich, the young (26) Argentine pianist who has been winning international competitions since she was 16, gives the sizzlingly intricate and tricky Prokofieff 3rd the best performance presently in the LP catalog. She not only tosses off its most difficult passages with ease and spirit, but also understands that underneath all the dissonant clatter Prokofieff was one of this century's most lyrical composers. She is matched in all this by former Bernstein assistant Abbado, who leads a knockout accompaniment. In the Ravel concerto, overside, both Argerich and Abbado fare better with its lyrical middle movement than they do with its jazzier outer sections. It is, however, a respectable if straightlaced performance. And DGG's sound engineering is beautiful. (R.H.)

The Pops Goes Latin—Boston Pops, Arthur Fiedler [*RCA Victor LSC2988*]. Fiedler has always been comfortably "at home" with Latin tempos. Perhaps it's because he's spent so much time conducting in Latin America. Or perhaps it's because the first big Boston Pops "hits" back in the 1930's were "The Carioca" and "Jalousie" (the latter Victor Red Seal's first million seller). This time 'round Fiedler serves up some recent Herb Alpert/Tijuana Brass hits ("Spanish Flea," "Taste of Honey," "Tijuana Taxi") plus some Stan Getz/Bossa Nova classics ("Desafinado" and "Manha de Carnaval"). Overside he zips spiritedly though the rhumbas, tangos, guarachas, and congas of Morton Gould's delightful *Latin-American Symphonette,* then winds up the show with Falla's brilliant "Ritual Fire Dance." It's Fiedler's best disc in years—and that's saying plenty. (R.H.)

FOLK ALBUM OF THE WEEK **John Wesley Harding—Bob Dylan** [*Columbia CS9604*]. Dylan has returned to the world. After 18 months of self-imposed exile he has fashioned a new album of original folk tales and mild comment songs sung in his raspy, mellow, speaksing style. In it Dylan eschews the hard-rock bag and obscure images of two years ago, and instead concentrates on Dylan as story-telling folksinger, poet, and legend-maker. "I Dreamed I Saw St. Augustine," "The Wicked Messenger," and the title song struck this reviewer's ear as the best of the album's 12 tunes—but *all* the selections are fine, honest, ungimmicked examples of one of this generation's foremost folk spokesmen. (R.M.)

Choice of the CHAMPIONS

CARL YASTRZEMSKI
1967 A. L. Triple Crown Winner
B.A. — .326
Home Runs — 44
RBI'S — 121

ROBERTO CLEMENTE
1967 N. L. Batting Champion — .357

HARMON KILLEBREW
A. L. Co-Champion
Home Runs — 44

ORLANDO CEPEDA
1967 N. L. RBI Champion — 111

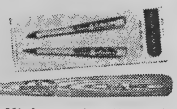
HENRY AARON
1967 N. L. Home Run King — 39

LOUISVILLE SLUGGER® BATS HILLERICH & BRADSBY CO. LOUISVILLE, KY.

Famous Slugger Yearbook
Ready soon at your dealers. Get your copy from him or send 10¢ direct to us (coin) to cover mailing.

LOUISVILLE SLUGGERS

Famous Slugger Pen-Pencil Set in gleaming gift package 50¢ complete



16"-Louisville Slugger Miniature Bat 50¢ each

HILLERICH & BRADSBY CO., P. O. Box 506 Dept. SM-8
LOUISVILLE, KENTUCKY 40201

Please send me_____Pen and Pencil Sets @ 50¢ each.
_____Miniature Bats @ 50¢ each _____Famous Slugger Yearbook @ 10¢ each

PLEASE PRINT
Name_____
Address_____
City and State_____
Please include Zip Code #_____

Just smile and they'll never notice that blemish on your chin.

C'mon.

You don't believe that.

And if *they* don't notice it, *you* do.

So why not try to get rid of it.

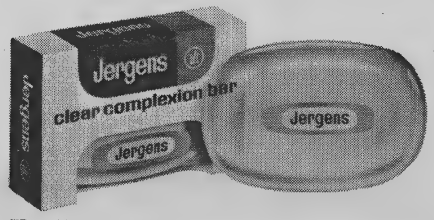
Just wash your face with Jergens Clear Complexion Bar.

It's an oil-hating, gentle-cleansing, bacteria-fighting, medicated complexion aid. And it'll do more to help get rid of pimples than all the fancy claims in the world.

Wash your face with it twice a day, and pretty soon, when you smile, maybe all they'll notice is your smile.

And that's something to smile about.

Jergens Clear Complexion Bar: Not just any old soap.



FROM THE JERGENS SKIN CARE LABORATORIES

ANSWERS ON PAGE 2

brainteasers

Penny-Wise

The grandfather of Tom, Dick, and Harry said he would give the three boys gifts, provided they could divide the gifts among them equally. He gave the brothers seven piggy banks full of pennies, seven piggy banks half full of pennies, and seven empty piggy banks. How can the pennies and banks be divided so that each brother gets an equal share, and no pennies are removed from the banks?

John Panella
Anne M. Dorner Middle School
Ossining, N. Y.

In Gear

Consider a row of seven interlocking gears of various sizes. The drive gear at one end of the row turns clockwise, providing the power which turns the other six gears. In what direction will the seventh gear, at the end opposite the drive gear, be turning?

Stephen Austin
Foothill Intermediate School
Walnut Creek, Calif.

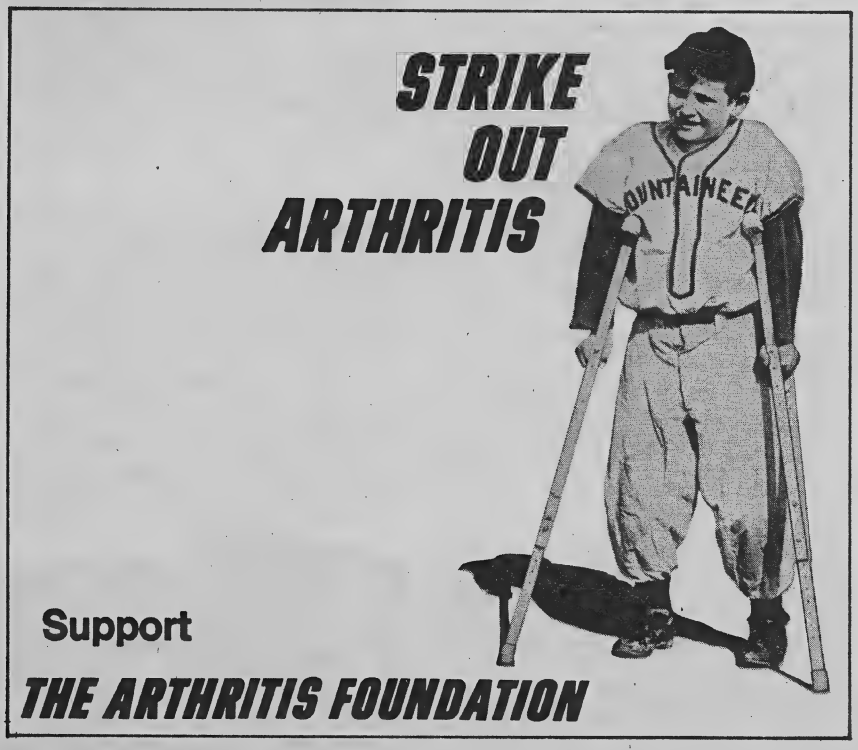
Challenging

A few weeks ago this column challenged its readers to use the digits 0 through 9 in such a way that they produce a result of 100. David Levy of Shaker Heights, Ohio, sent us a letter referring us to *Amusements in Mathematics* by H. E. Dudeney. This book presents eleven solutions to the problem, with the added restriction that the digits must appear in consecutive order from 0 through 9. Some of these solutions involve negative numbers, but four are perfectly straightforward. If you can find one way to use the digits 0 through 9 in consecutive order to produce a result of 100 you are doing well. Find two ways and you're way ahead of the game. Find three ways and you're almost unbeatable. Find four ways and – forget it.

Do you have a favorite brain teaser? Send it to Senior Science, 50 West 44th St., New York, New York 10036. We will pay five dollars for each one published. Include the name of your school, home address, grade, and age. In case of duplicate submissions, choice will be made on the basis of presentation and clarity.

Editor's Choice

A coin collector had nine coins which appeared to be identical. However, he knew that one weighed less than the other eight. Using a balance scale, how could he identify the underweight coin with just two weighings on the scale?



nutrition

Letters come to us all the time from young girls who think they're underweight. "Please help," they plead. "I'm skinny Minnie, and I can't seem to put on any weight. What can I do?"

Slow Down!

Slow down and pay attention. Also, you might just plain slow down. There's a good chance that you're eating your share of fats and carbohydrates, but you're also running around like a chicken with its head cut off, and so you're burning up those calories before they have a chance to do any good for your figure.

Maybe, too, you're not getting enough rest and sleep. If you've ever been out with the family for a big Sunday dinner, you know that often the first suggestion made afterward is, "Let's walk off some of this meal." Walking is, of course, exercise, and so you simply exercise some of those calories away.

Now, what about the reverse? We're not suggesting you don't get any exercise. But we *are* suggesting that you balance it with a lot of rest and sleep, two things that help the extra calories to work for you. If you're always running, and never resting, you can't expect calories to do you any good in the weight department. They simply won't hang around long enough!

How Many Calories?

Always consult your doctor before going on any diet. But here is how one girl checked her calorie intake against her weight to see if she was eating enough.

Skinny Minnie weighed 100 pounds. She multiplied that weight by 20. That's 2,000 calories. And that's about what she ate every day. She burned up all she ate, so of course she didn't gain weight.

Minnie had to increase her calorie intake to gain weight. A smaller girl on Minnie's diet might gain weight, while a larger girl would lose. Multiply your own weight by 20 to find out how many calories you probably need every day without gaining or losing. Then consult your doctor before changing your eating habits.

Okay, now how do you add those 500 or so calories every day? Here are a few pointers:

For one thing, you can eat more often than you usually do. The more you eat, of course, the more calories you'll be adding to the list. Try not to drink too much water or other beverages while you're eating a meal. Liquids fill you up and don't allow as much room for the food you need to gain.

Eat foods that give you a lot of calories for the little room they'll take in your stomach. In other words, don't fill up on bulky foods that will not give you your "money's" worth. Eat nourishing high-calorie foods that won't necessarily fill you up — like ice cream, bread and butter, etc.

When you're thirsty, try to drink milk instead of water. Water just isn't fattening!

Don't worry about a poor appetite. That's probably part of your problem, all right, but the more you get used to eating, and the better you feel, the more your appetite will grow.

Bend and Stretch

You probably know the value of exercise when you're on a diet to lose weight. You know that, while you're taking off excess pounds, you can also distribute the weight by strengthening certain muscles.

Well, believe it or not, the same holds true for weight-gainers. While you're consciously trying to add pounds, you must also exercise to keep that extra weight in line. You don't want just a heavy accumulation of fat, do you? Of course not.

Exercise daily. Don't worry that you'll be taking off all the weight you just finished putting on. You won't be. You'll just be turning that weight into muscle instead of flab. You should wait until you've put on some weight before starting an exercise plan. But once you start, stick to it!

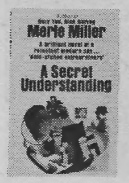
$AVE A BUNDLE!

ANY 2 BOOKS $1.00

Here's Part II of our warehouse clearance (if you didn't order last month, too bad for you)! Choose any 2—or 4, or 6—of these adult best-sellers. Fill out the order form and send it to Scholastic. Presto: instant book bargains! But hurry: this offer is valid only until April 20.

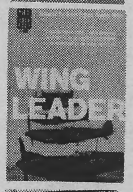
1. IN THE HEAT OF THE NIGHT, Ball. Award-winning detective thriller. Sidney Poitier starred in the hit movie!

2. THE I HATE TO HOUSEKEEP BOOK, Bracken. Hilarious household hints by a very funny lady whose quick tricks really work.



3. A SECRET UNDERSTANDING, Miller. A magazine writer on a story about a missing war "hero" finds out how deadly the spy game can be!

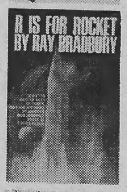
4. THE LOVELY WORLD OF RICHI-SAN, Bosworth. An American officer meets a Japanese widow—and a new world of beauty and friendship.



5. WING LEADER, Johnson. Britain's top-scoring Spitfire pilot tells how it was in World War II, from 1939 to VE Day.

6. FOREVER FREE, Adamson. Remember **Born Free?** Here's the sequel: the Adamsons' fight to save Elsa's cubs!

7. THE TAMING OF THE SHREW, Shakespeare. Wildly funny—but look out, girls! It may give the boys ideas about taming **you!** Hit movie starred you know who.

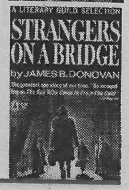


8. R IS FOR ROCKET, Bradbury. Nobody beats Ray Bradbury for chills down the spine! 17 weird, wonderful tales.

9. JAMAICA INN, du Maurier. Suspenseful story of treachery, intrigue, and romance, by the famous author of **Rebecca.**

10. MAN HIGH!, Simons. 75,000 feet above the earth, a daring man explores the stratosphere —in a fragile balloon!

11. THE UNFORGIVEN, LeMay. "Grim, powerful, magnificently written" **(N. Y. Times)** novel of love and hate on the western frontier. Movie hit.



12. STRANGERS ON A BRIDGE, Donovan. At midnight, they met to exchange top Russian and American spies! Fascinating story —all true.

Scholastic, 904 Sylvan Avenue, Englewood Cliffs, N. J. 07632. Please send the books indicated at 2 for $1.00. I enclose full payment.

☐ 1. In The Heat of The Night ☐ 4. Lovely World of Richi-San ☐ 7. Taming of the Shrew ☐ 10. Man High!

☐ 2. I Hate to Housekeep Book ☐ 5. Wing Leader ☐ 8. R Is For Rocket ☐ 11. The Unforgiven

☐ 3. A Secret Understanding ☐ 6. Forever Free ☐ 9. Jamaica Inn ☐ 12. Strangers On A Bridge

Summary No. SS-38	PAYMENT MUST ACCOMPANY ORDER	AMOUNT ENCLOSED ☐	TOTAL BOOKS ☐

NAME _____ SPECIAL FOURTH CLASS RATE — BOOKS

ADDRESS _____

CITY _____ STATE _____ ZIP _____

SCHOLASTIC BOOK SERVICES, 904 Sylvan Avenue, Englewood Cliffs, N. J. 07632

This offer valid in U.S. and territories only. Not valid in Canada.

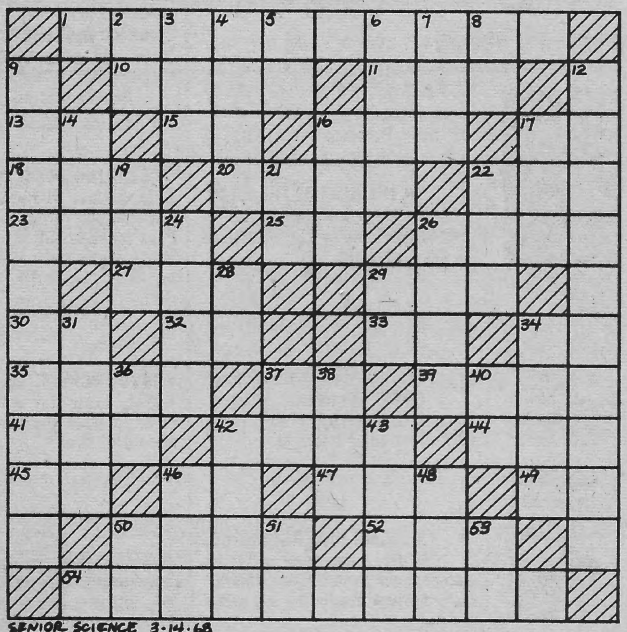
Electrified

By Wilf Tosczak

South Peaces Sr. Secondary S., Dawson Creek, British Columbia

★ **Starred words refer to electronics**

Students are invited to submit original crossword puzzles for publication in *Senior Science*. Each puzzle should be built around one topic in science, such as astronomy, astronautics, botany, geology, electronics, famous scientists, etc. Maximum of 50 words, of which at least 15 must be related to the theme. For each puzzle published we will pay $10. No entry will be considered unless it includes all of the following: symmetrical puzzle design and design with answers filled in, definitions, answers on separate sheets, and a statement by the student that the puzzle is original and his own work. **Puzzles must be symmetrical.** Keep a copy, as puzzles cannot be returned. Give name, home address, school, and grade. Address: Puzzle Editor, *Senior Science*, 50 West 44th Street, New York, N. Y. 10036. Answers to this puzzle are on page **28**



ACROSS

* 1. Stores electrical energy.
10. Movie.
*11. Ultrahigh frequency *(abbr.)*.
13. Printers' measure.
15. Canadian province *(abbr.)*.
16. International Brotherhood of Magicians *(abbr.)*.
17. On order *(abbr.)*.
18. Source of energy.
20. One time only.
22. Official *(abbr.)*.
23. Thought.
25. A ligature.
*26. High fidelity *(slang)*.
27. Suffix used to denote a tumor.
29. Friend.
30. Disease that usually affects the lungs.
32. Not Ma.
*33. A type of radio signal *(abbr.)*.
34. Abbr. for a handwritten work.
35. Exclamation of sorrow.
*37. Type of electric current *(abbr.)*.
39. Cut.
41. Short sleep.
*42. Negative force applied to grid of tube.
44. Irish Cyclists' Association *(abbr.)*.
*45. Citizen's band *(abbr.)*.
46. On the right-hand page *(Lat. abbr.)*.
47. Boy's name.
49. Preposition.
50. Ancient pagan god.
*52. Very high frequency *(abbr.)*.
*54. Converts sound waves into electric signals.

DOWN

* 2. Audio frequency *(abbr.)*.
3. Target in bowling.
4. In addition.
5. A unit in the metric system *(abbr.)*.
* 6. Vacuum-sealed electrical grid.
* 7. Unit of resistance.
* 8. Radio frequency *(abbr.)*.
* 9. Property of a substance by which it impedes the flow of electrons.
*12. Without moving parts *(2 words)*.
14. Soil and water.
16. Frozen water.
17. On *(antonym)*.
19. Prefix meaning "new."
21. Negative reply *(Scot.)*.
22. Petroleum.
*24. Units of current.
*26. Amateur radio operators.
28. Author's alterations *(abbr.)*.
*29. A unit that equals a micro-micro-farad *(abbr.)*.
31. To reveal by speech.
34. Type of silicate.
36. A news service.
37. Prefix meaning "twice."
38. Dog's natural enemy.
40. Lightest metallic element *(chem. sym.)*.
42. Wild pig.
43. 19th, 9th, and 8th letters.
46. Abbr. for British association similar to A.A.A.
*48. Unit of conductance.
50. Prefix meaning "two."
51. Local *(abbr)*.
53. Footnote *(abbr.)*.

Science on TV

Star Trek

(Fri., March 15, 8:30 P.M. EST, NBC-TV)

Captain Kirk and his officers, searching for survivors of a lost ship, become prisoners of the despotic ruler of a planet complete with modern technology and Roman Empire customs in this week's story of *Bread and Circuses*. The cast reflects the contrast in eras: There's Septinus, peaceful leader of the slaves; Flavius, champion gladiator; and Claudius Marcus, who keeps the population in line by staging TV spectaculars of gladiatorial competitions. Into all this come Kirk, Spock, and the rest of the *Enterprise* crew – and they're happy to escape with their lives.

Animal Secrets

(Sun., March 17, 5:00 P.M. EST, NBC-TV)

A filmed report on *Aggression – or Love* includes a special look at research being done in U. S. laboratories on the question of instinct versus learning. Can aggression be controlled? Does punishment produce aggression? What causes animals, including man, to turn to their fellows in violence? Dr. Loren Eiseley reports on recent studies in the field of aggression.

Wild Kingdom

(Sundays, 7:00 P.M. EST, NBC-TV)

March 17: A family of leopards has taken over an ancient deserted castle in Rajasthan, India. *Leopards of Sawai Madhopur* tells the story of those leopards and the other animals that live nearby, through the use of excellent film footage.

March 24: *Arctic Adventure*, one of the series' most exciting shows, features a trip to the top of the world – the remote regions near the Arctic Circle – for a polar bear hunt and a walrus capture. This is a journey to the seldom-seen land of the Eskimo, where musk ox, caribou, and arctic wolves make their homes.

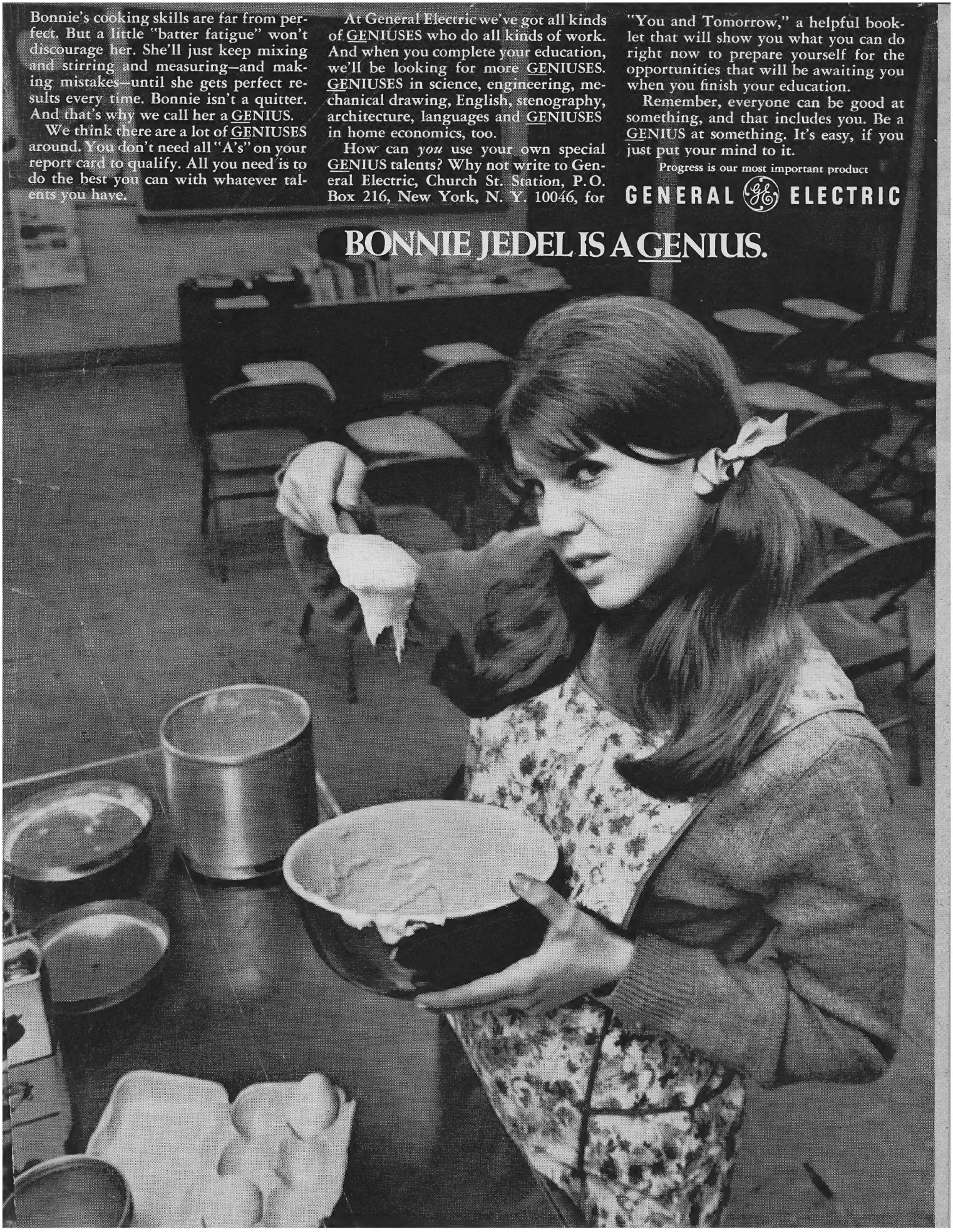
Voyage to the Bottom of the Sea

(Sun., March 17, 7:00 P.M. EST, ABC-TV)

Henry Jones guest stars as the evil Mr. Pem in *No Way Back*. Pem uses his time transferal device to return the *Seaview* and its crew to the Revolutionary War period – where he attempts to help the British win, and keep Benedict Arnold from being captured by the Americans.

– PEGGY HUDSON

BONNIE JEDEL IS A GENIUS.



Bonnie's cooking skills are far from perfect. But a little "batter fatigue" won't discourage her. She'll just keep mixing and stirring and measuring—and making mistakes—until she gets perfect results every time. Bonnie isn't a quitter. And that's why we call her a GENIUS.

We think there are a lot of GENIUSES around. You don't need all "A's" on your report card to qualify. All you need is to do the best you can with whatever talents you have.

At General Electric we've got all kinds of GENIUSES who do all kinds of work. And when you complete your education, we'll be looking for more GENIUSES. GENIUSES in science, engineering, mechanical drawing, English, stenography, architecture, languages and GENIUSES in home economics, too.

How can *you* use your own special GENIUS talents? Why not write to General Electric, Church St. Station, P.O. Box 216, New York, N. Y. 10046, for "You and Tomorrow," a helpful booklet that will show you what you can do right now to prepare yourself for the opportunities that will be awaiting you when you finish your education.

Remember, everyone can be good at something, and that includes you. Be a GENIUS at something. It's easy, if you just put your mind to it.

Progress is our most important product

GENERAL ELECTRIC

Clean Make-up

It's better for your skin than no make-up at all.

That's Cover Girl Medicated Make-up. It does everything a good make-up's supposed to do. Like looking pretty. Hiding "things". Covering smoothly, without caking or turning funny colors. And then it does something no other make-up can do: protects your skin with Noxzema medication. The look is clean. The feeling is clean. It all adds up to make-up that's good for your skin!

Cover Girl®

Medicated Make-up by Noxzema

Noxell CORPORATION Owner of the Trademark Names—Cover Girl and Noxzema.